Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

SEPTEMBER, 1949

TECHNOLOGY DEPARTMENT

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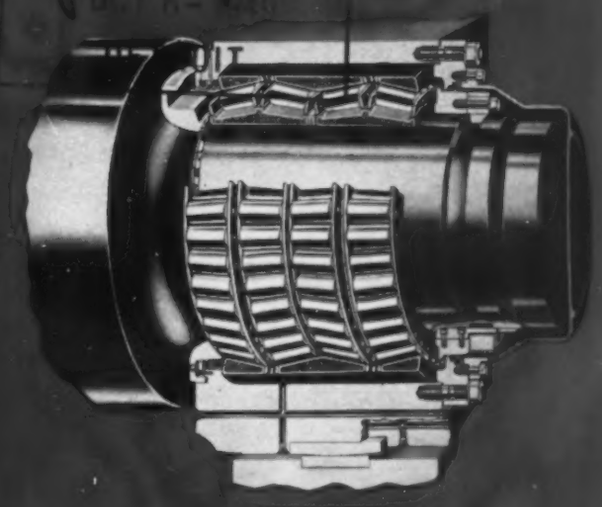
for BIGGER, STRONGER, ROLL NECKS



To help give your rolling mills maximum rigidity and prolong roll life, specify Timken Balanced Proportion bearings for all back-up and work rolls.

Timken Balanced Proportion bearings now make possible bigger, stronger mill roll necks in addition to all of the other well-known advantages of tapered roller bearings namely: elimination of friction; simplicity and ease of lubrication (no pipes, pumps, etc.); radial, thrust and combined load capacity (no special thrust bearings needed); ease of roll changing; restarting of mill after stops without relieving roll pressure and loss of steel.

Timken roll neck bearings are made of Timken special alloy steel with case-hardened contact surfaces and tough inner core for maximum resistance to wear, loads and shock. Applicable to existing and new mills. Consult our roll neck bearing specialists for specific information.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
ROLL NECK BEARINGS

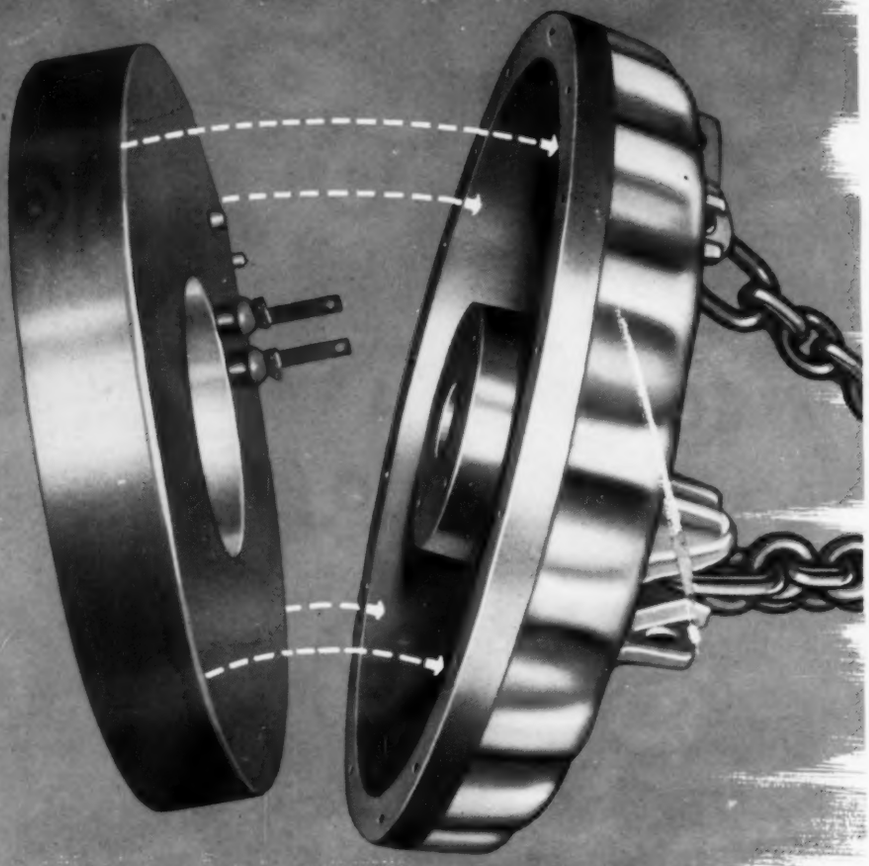
THE TIMKEN ROLLER BEARING COMPANY
CANTON 6, OHIO · CABLE ADDRESS "TIMROSCO"

JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

Now!

CAPSULE-COIL Magnet Construction

FOR LONGER LIFE AND EASY ON-THE-JOB COIL REPLACEMENT



Now!

New anti-wear features prolong chain life

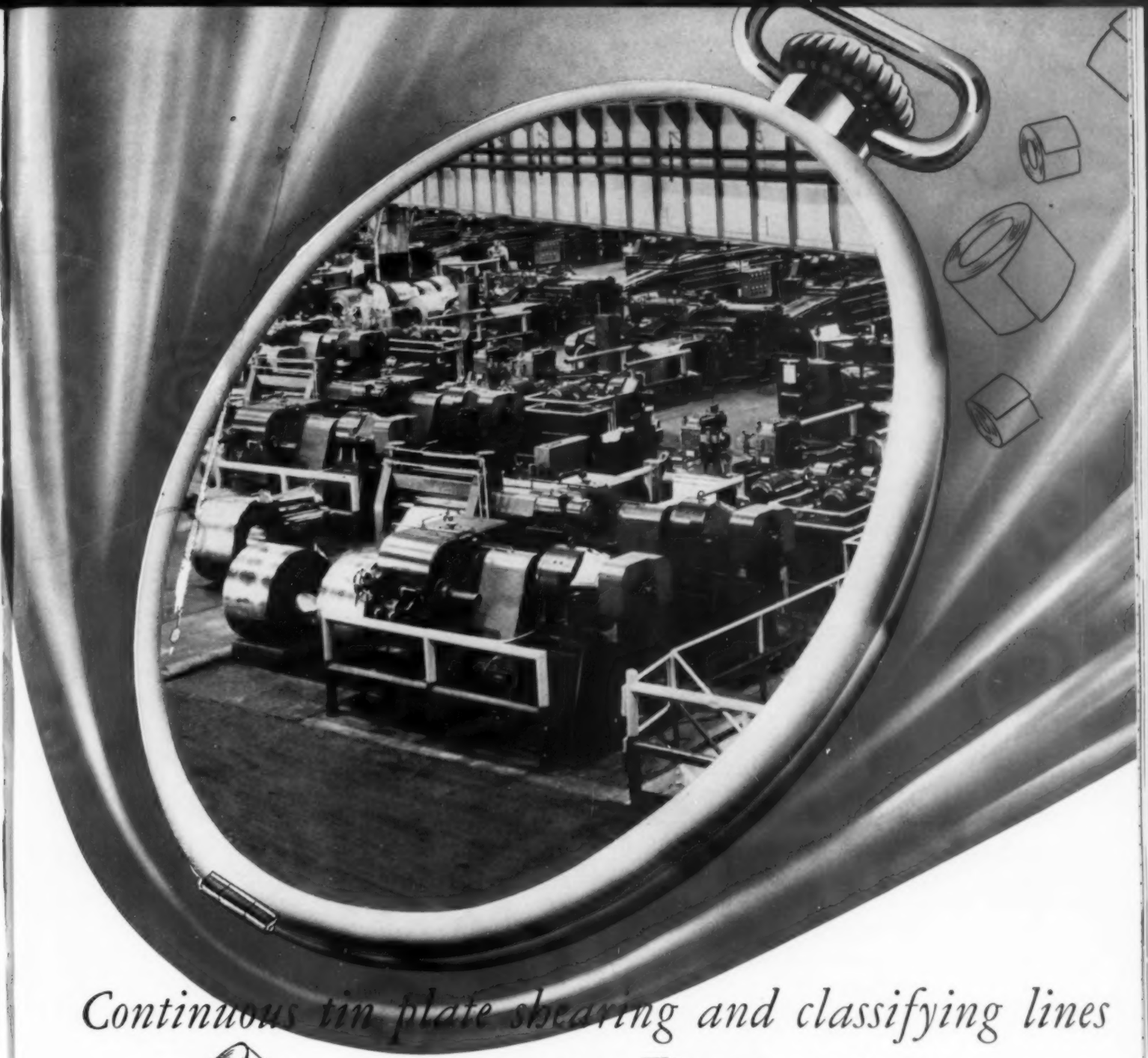
Cutler-Hammer Supermagnets now embody a new welded, steel-sheathed CAPSULE-COIL sealed against moisture. With this new design plus removable pole shoes *YOU CAN REPLACE A COIL* easily, quickly and with a minimum of "time-out." For coil repairs, only the CAPSULE-COIL need be returned to the manufacturer. With a spare CAPSULE-COIL replacement, your Supermagnet goes back to work at once.

Also NEW, a radically different chain suspension, replacing the conventional top link with a new "non-twist," anti-wear yoke. This, plus redesigned, streamlined body lugs, materially eliminates trouble at the spots where chain usually wears out.

These major Cutler-Hammer advances match other Supermagnet features . . . high permeability steel spool, part of magnetic path . . . strap copper windings insulated by impregnated asbestos ribbon . . . high dielectric, bonded, mica discs between coil layers and CAPSULE case . . . an improved impregnation and insulating process. These superiorities—the result of 50 years of engineering leadership—merit your selection of "Cutler-Hammer" for your next magnet requirement . . . CUTLER-HAMMER, Inc., 1257 St. Paul Ave., Milwaukee 1, Wisconsin.

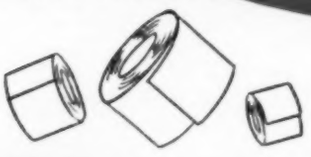
CUTLER-HAMMER
SUPERMAGNETS
C-H

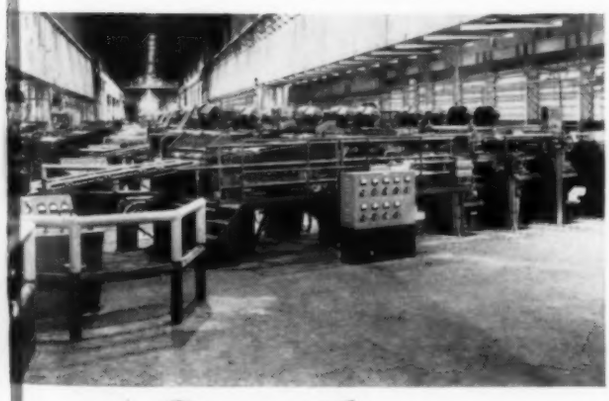
IRON AND STEEL ENGINEER, published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania under Act of Congress March 3, 1879. $7.50 per year in United States and Canada, $10.00 foreign countries. Volume 26, No. 9.

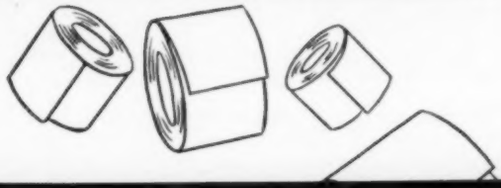


Continuous tin plate shearing and classifying lines

1,000 feet per minute







• Aetna-Standard and Carnegie-Illinois engineers worked hand in hand to produce these 5 complete shearing and classifying lines now operating at the Gary plant of Carnegie-Illinois.

The lines include Hallden Shears, Aetna-Standard's patented payoff reels, side trimmers, high speed side trimmers and the latest development in Kaufman classifying tables. This combination makes possible flying shear speeds of 1,000 ft. per minute.

A pioneer in continuous-coating equipment, tin plate, terne plate and galvanizing lines, Aetna-Standard builds complete lines using any reliable type flying shear you choose.

This company has built many continuous terne, galvanizing and tin plate lines. Consult Aetna-Standard's flat-rolled specialists about your requirements.

THE AETNA-STANDARD ENGINEERING COMPANY
YOUNGSTOWN, OHIO
ASSOCIATED COMPANIES:
HEAD, WRIGHTSON & COMPANY, LTD., THORNABY-ON-TEES, ENGLAND
AETNA-STANDARD ENGINEERING COMPANY, LTD., TORONTO, ONTARIO, CANADA

Hyde Park...

CHILLED ROLLS

RED CIRCLE Rolls CHILLED

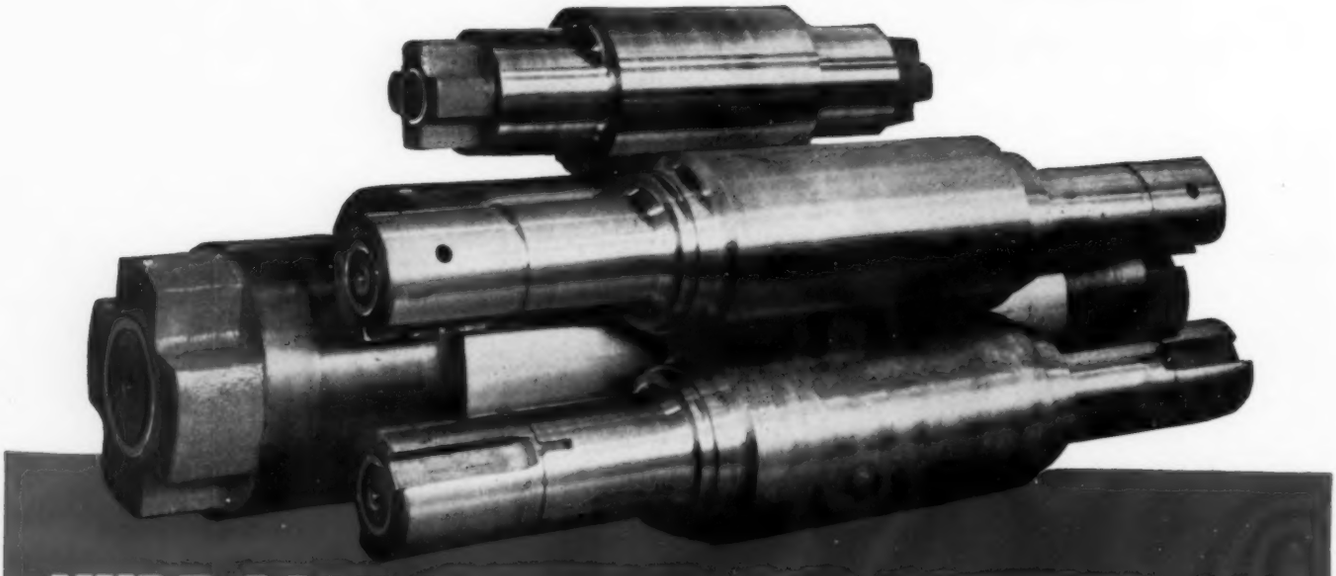
ROLLING MILL MACHINERY

Outstanding in quality and in performance in routine service, Hyde Park Rolls and Rolling Mill Machinery have enjoyed the respect and the confidence of the industry for more than fifty years. Hyde Park Rolls for every purpose may be quickly identified by the Red Circle. Heat-treated Alloy and plain chilled Rolls, Moloy Rolls, Nickel chilled, Grain Rolls, Cold Rolls and Sand Rolls. Rolling Mill Equipment of all kinds, Mills, Tables, Stretcher Levelers, Shears, Gears and Pinions, Special Machinery.

GRAY IRON AND ALLOY IRON CASTINGS

Castings of any size up to 80,000 pounds. Hyde Park facilities are equal to your every requirement. Furnace Castings, Machinery Castings, Slag Pots, Bases, Lathes, Heavy Tools, Housings, etc.

Let Hyde Park quote on your next requirements. Phone or write. Hyde Park service is prompt.



HYDE PARK FOUNDRY AND MACHINE CO.
Hyde Park, Pa. (Pittsburgh District)

Use the heavy-duty lubricant that prolongs gear life—Texaco Meropa

TEXACO *Meropa Lubricants* are especially made to protect enclosed reduction gears and their bearings in heavy-duty service. They keep the gear teeth coated with load-carrying lubricant that wards off wear, assures smoother operation, longer gear life. Their use materially reduces maintenance costs.

Throughout their exceptionally long service life, *Texaco Meropa Lubricants* will resist oxidation and thickening. They will not foam . . . nor will they separate in service, storage or centrifuging. Your gears will have full protection at all times.

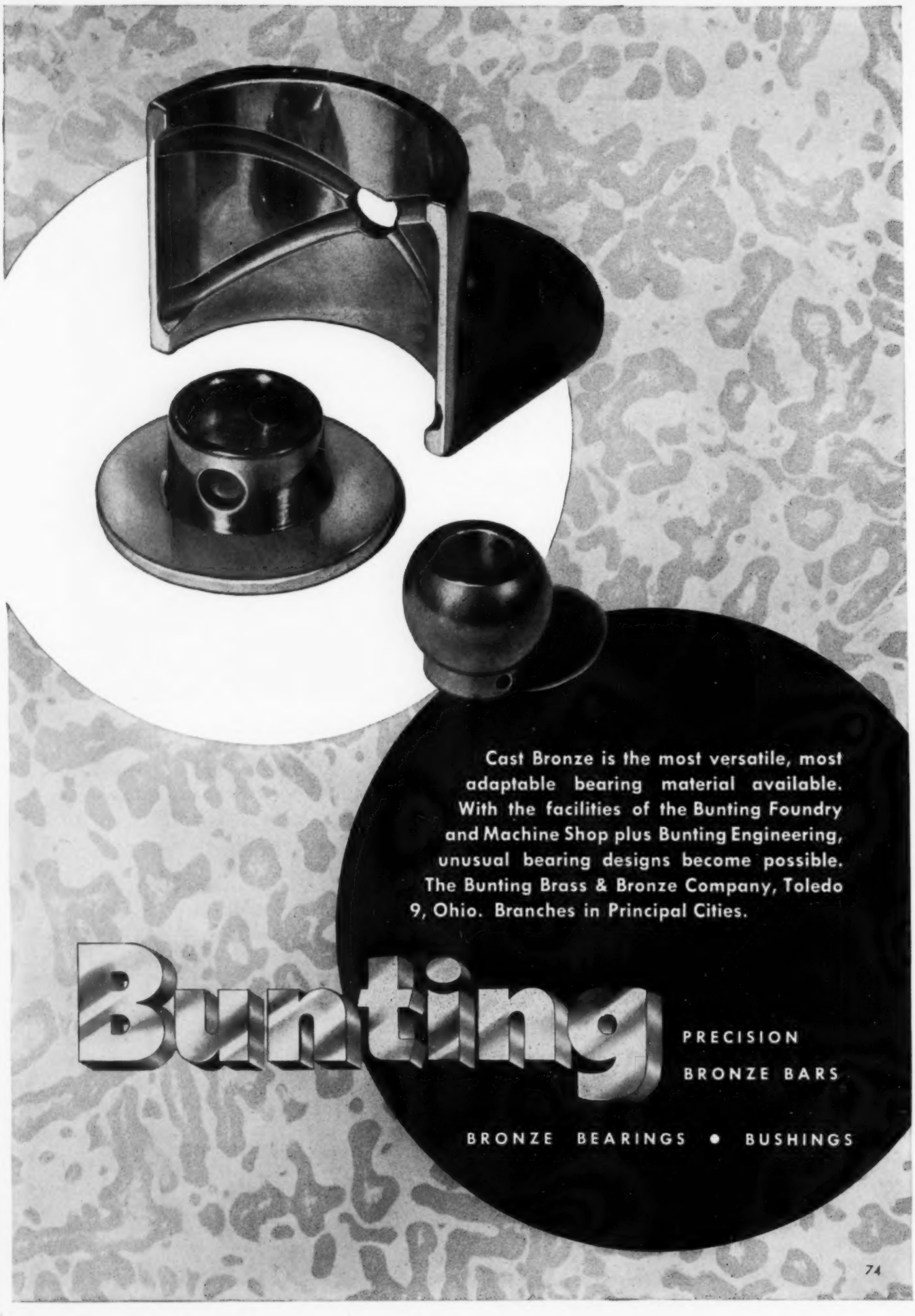
To protect your oil film roll necks, use *Texaco Regal Oils*. These heavy-duty, turbine-grade oils are highly resistant to oxidation, emulsification and sludging, and will keep circulating systems clean.

For top efficiency and economy throughout your plant, use effective lubrication — *Texaco*. Your Texaco Lubrication Engineer will gladly assist you. Just call the nearest of the more than 2300 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Meropa Lubricants

FOR STEEL MILL GEAR DRIVES


Cast Bronze is the most versatile, most adaptable bearing material available. With the facilities of the Bunting Foundry and Machine Shop plus Bunting Engineering, unusual bearing designs become possible. The Bunting Brass & Bronze Company, Toledo 9, Ohio. Branches in Principal Cities.
Bunting
PRECISION
BRONZE BARS
BRONZE BEARINGS • BUSHINGS
74

NEW SQUARE D "PLUG-IN" CONTROL CENTERS

above
• Size 2 plug-in starter unit

right
• Disconnect operator handle

NOW ... *take full advantage of Control Center convenience, safety and economy . . . Square D "PLUG-IN" centers are new from the ground up, with all basic features plus . . .*

NEW INSTALLATION ECONOMY. Wiring channels are all accessible from front without removing units. Two big vertical channels per section permit separation of power and control circuits.

NEW SPACE ECONOMY. Up to six starters fit in 20" x 20" x 90" sections. Standard 20" depth sections will accommodate starters through size 5.

NEW SAFETY DISCONNECT OPERATOR. One to four padlocks will lock both door and disconnect in either "ON" or "OFF" position. On closing unit door, handle moves to indicate position of disconnect. When not padlocked, authorized person with tool can release door interlock to inspect control without interrupting power.

NEW FLEXIBILITY. For simplest plant conversion or maintenance, plug-in units slide on guide brackets and positive pressure stabs grip round vertical busses. Plant conversion is simplified and minor changes often will not require shutting off power.

Square D's NEW Control Centers are also available in water-tight, dust-tight and weather-resistant enclosures. Contact your nearby Square D Field Engineer for complete information, or

Write **Square D Company, 4041 N. Richards Street, Milwaukee 12, Wisconsin**

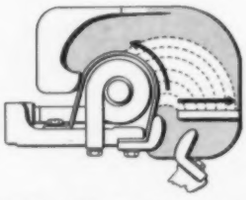
SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

SQUARE D COMPANY CANADA LTD., TORONTO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.

Complete Control for Cranes

SHORT - THROW, Narrow Width Cam Master Switches are easy on the operator.



LINE - ARC Contactors — no destructive arc shield burning.

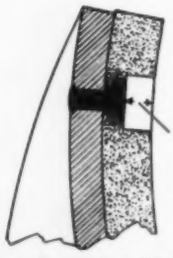
ONLY ONE moving part in the TIME-CURRENT d-c acceleration relay.

YOUNGSTOWN Safety Limit Stop removes fear of overhoisting accident.

Type WB Brake showing how the motor armature is easily lifted out. At top left is the handle-nut for compressing the spring when removing motor armature, changing brake shoes, and for manual control.

Long Life Brakes for A-C and D-C Motors by EC&M

The brake lining is molded to match curvature of wheel and shoe.

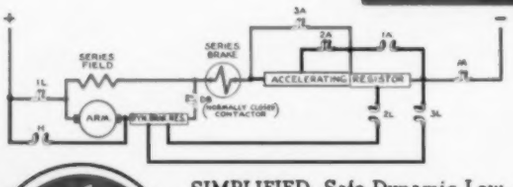


Actual wearing thickness, between rivet heads and brake wheel, is ⅛ inch on the smallest size to ½ inch on the largest size.

These Type WB Brakes for a-c and d-c service have a block type lining which is both thick and tough.

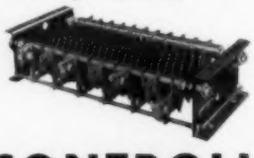
Furthermore, due to the process of manufacture, the blocks have proper frictional quality *throughout the entire thickness*, permitting uniform and complete wear down to rivet heads. And since the material is non-compressionable, brake adjustments are infrequent.

EC&M Type WB Brakes are built in several sizes. Send for Bulletins 1004 and 1006.



SIMPLIFIED, Safe Dynamic Lowering Circuits for hoist motion.

TAB - WELD Resistors — no burning where burning would cause high up-keep.



CRANE DISCONNECT SWITCH

Manual - Magnetic for ease of operation.

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET ★ CLEVELAND 4, OHIO

the mark of a perfect Roll.....

LEWIS FOUNDRY AND MACHINE

DIVISION of BLAW-KNOX COMPANY - PITTSBURGH, PA.

LEWIS ROLLS

LEWIS PLAIN CHILLED IRON ROLLS

LEWIS MOLYBDENUM CHILLED IRON ROLLS

LEWIS "X" AND "XA" ROLLS

LEWIS SUPERIOR "X" ROLLS

OVER 90 YEARS LEWIS OF ROLL MAKING

LEWIS ATLAS AND ATLAS "B" ROLLS

LEWIS SPECIAL PROCESS ROLLS

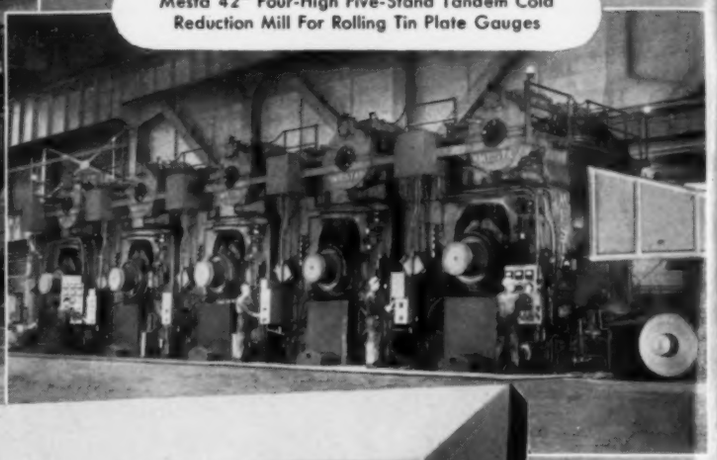
LEWIS AJAX DUPLEX ROLLS

LEWIS CLIMAX AND AJAX ROLLS

LEWIS SPECIAL TUBE MILL ROLL

MANUFACTURERS OF ROLLS AND ROLLING MILL MACHINERY FOR THE IRON, STEEL AND NON-FERROUS INDUSTRIES

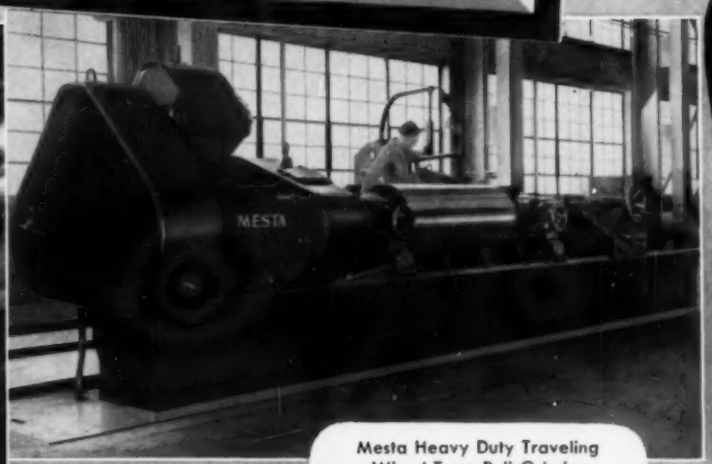
Finishing Stands for Mesta 68" Continuous Four-High Hot Strip Mill



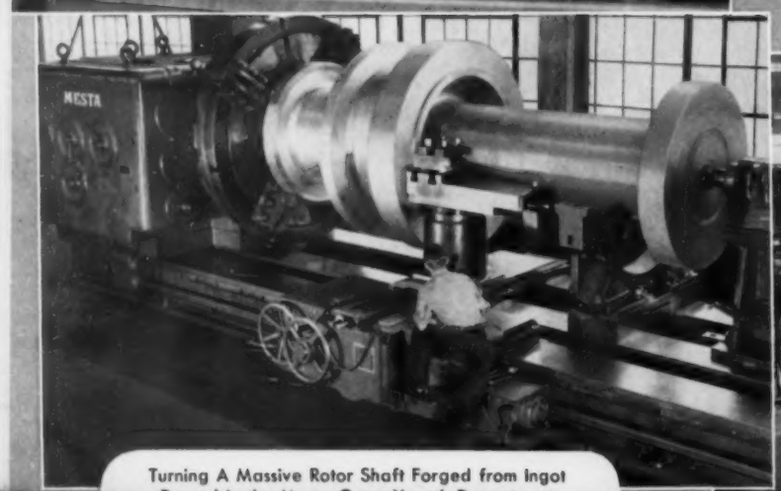
Mesta 42" Four-High Five-Stand Tandem Cold Reduction Mill For Rolling Tin Plate Gauges

Designed and Built by MESTA

56" x 138" Mesta Heat Treated Special Alloy Cast Steel Backing-Up Roll

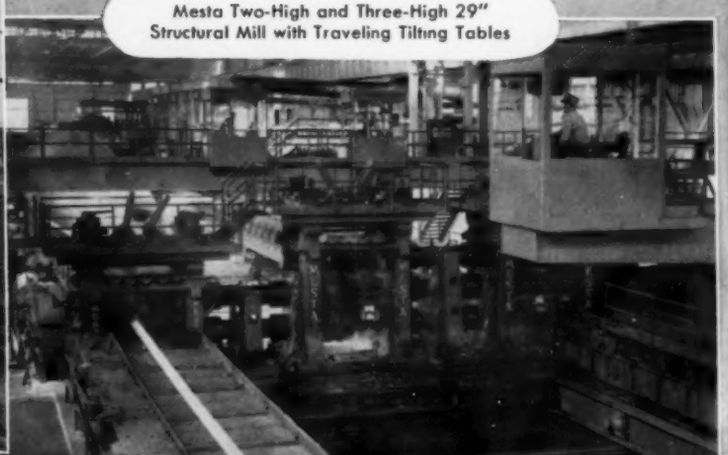


Mesta Heavy Duty Traveling Wheel Type Roll Grinder

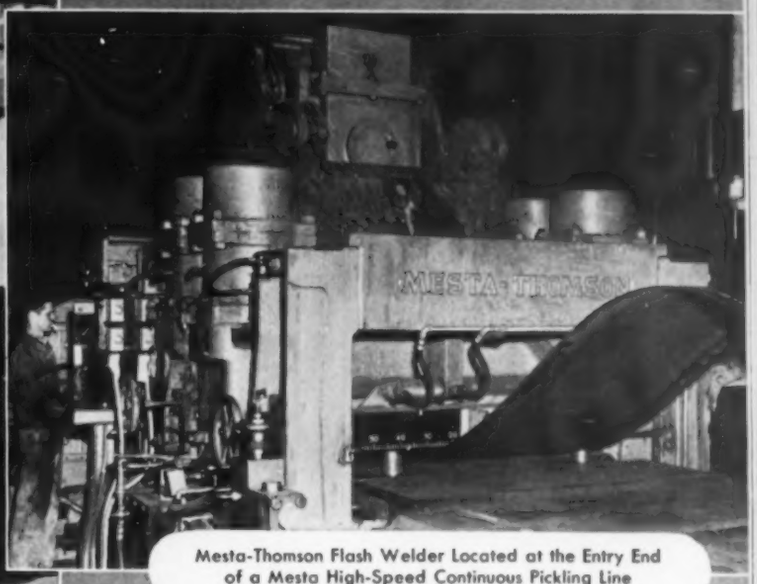


Turning A Massive Rotor Shaft Forged from Ingot

Mesta Two-High and Three-High 29" Structural Mill with Traveling Tilting Tables



Mesta 36" Reversing Blooming Mill with Manipulator and Tilting Fingers



Mesta-Thomson Flash Welder Located at the Entry End of a Mesta High-Speed Continuous Pickling Line

Mesta 66" Continuous Pickling Lines with Trimmers and Up-Coilers

Mesta 180" Leveller for Heavy Aluminum Plate

DESIGNERS AND BUILDERS OF COMPLETE STEEL PLANTS

MESTA MACHINE COMPANY · PITTSBURGH, PA.

Mesta 18"-14" Merchant Mills with Pack Annealing Cooling Bed and Equipment

Vertical Edger and Two-High Roughing Stand for Mesta 68" Continuous Hot Strip Mill

high-speed rod and merchant mill uses amplidyne control -to help roll a wider variety of products!

Shown in this merchant-mill motor room are 6 of 13 G-E main-drive motors, rated 100 to 800 hp. The 4000-kw motor-generator set in the rear is driven by a 5600-hp, 514-rpm synchronous motor.

General Electric-engineered drive provides simple, flexible operation—helps roll more steel!

Add this as another example of steel mill drives equipped and co-ordinated by General Electric for modern, high-speed operation. It's the main drive recently installed in a large midwestern rod and merchant mill to roll billets into shaped steel products.

Accurate Speed Adjustment!

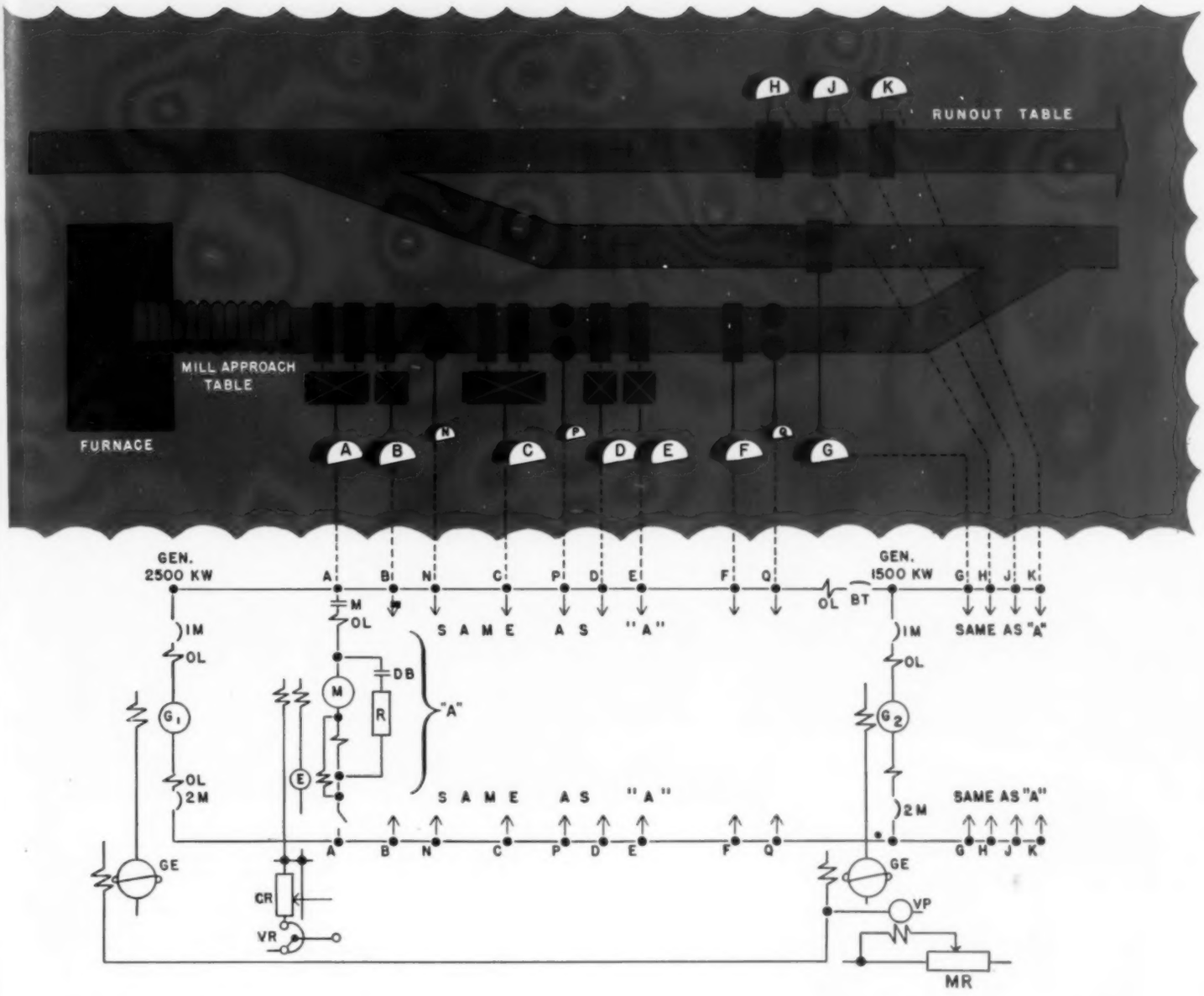
Driving its 15 stands are 13 main-drive motors in two groups. Each group is powered by a separate generator, with its voltage separately controlled by an amplidyne exciter. By providing a speed differential between groups of motors, a greater variety of products can be rolled.

Close Speed Regulation!

In addition, special characteristics built into the main-drive motors maintain a close, steady-state speed regulation, and minimize speed changes in each stand under sudden load changes. Thus, without speed regulators or electronic circuits, this drive provides simple fingertip control, requires less maintenance, helps roll more tons of good steel.

This installation—which also includes complete electric equipment for many auxiliaries—illustrates an important point: To serve the steel industry, General Electric couples experienced engineering skill with extensive manufacturing facilities. That's why you save time, trouble, and expense on drive problems when a G-E steel-mill specialist works with your technical staff. Why not call him at your nearest G-E office? ***Apparatus Dept., General Electric Company, Schenectady 5, New York.***

GENERAL ELECTRIC



In brief, here's how it works—

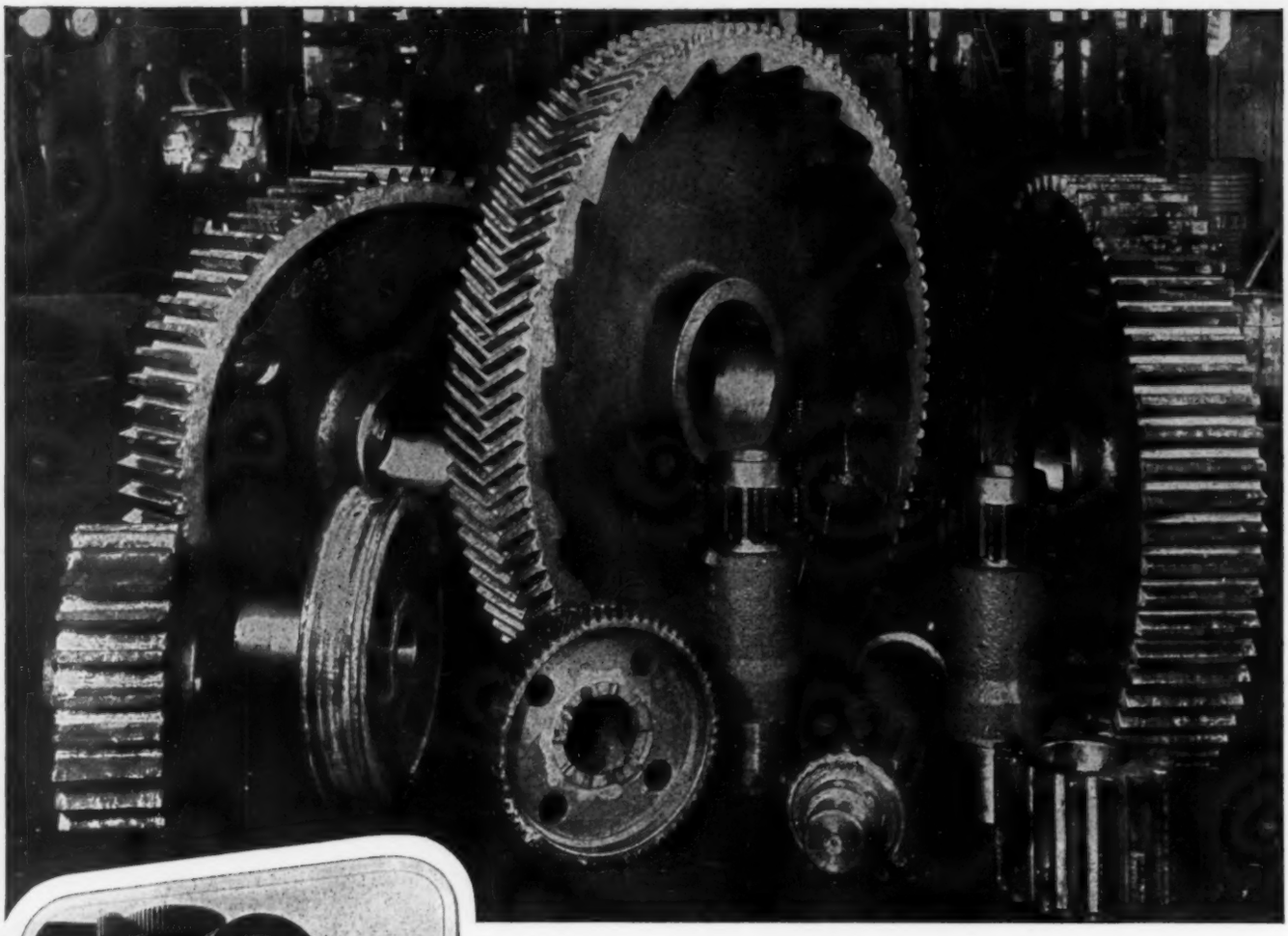
In the control circuit shown, the 13 main-drive motors (A thru K) are connected to two generator bus sections—one bus section being supplied with power by a 2500 kw—600 V generator (G1); the other being supplied with power by a 1500 kw—600 V generator (G2). The two generators may be operated at different voltages when the products being rolled require more than normal speed differential between the two groups of motors, or operated in parallel at the same voltage if schedules permit.

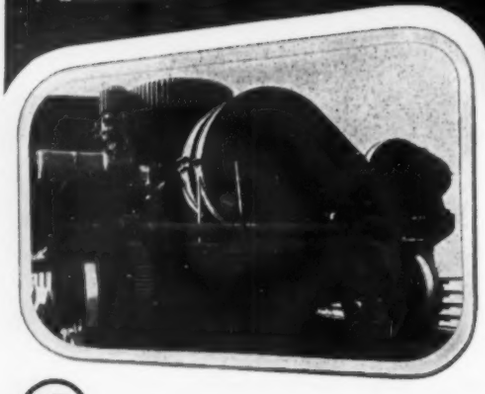
Voltages of both generators are automatically regulated to a predetermined value by the amplidyne generator exciters (G-E). The voltage is determined by the motor-operated rheostat in the field of the voltage pilot (VP).

The main shunt field of each stand motor is controlled by a motor-operated coarse-adjusting rheostat (CR) and a hand-operated vernier rheostat (VR). The auxiliary shunt field of each is excited by a series exciter (E) which measures the motor-load current and excites the motor auxiliary shunt field to maintain a steady-state speed regulation of not over 1½% at full load and full voltage.

Special transient-speed characteristics are built into the main stand motors (A thru K) to minimize the change in speed of each stand as the load suddenly changes.

another example of GENERAL ELECTRIC drive engineering at work!





NE

CRANE GEARS and TRACK WHEELS have *Greater Internal Stress Value* . . .

HERE IS WHY

FOR COMPARATIVE PURPOSES

we tabulate below the physical properties of the surface and core values of SAE-1020, SAE-2315, Steels, Carburized or Case Hardened with "NELOY" and "NELOY-MOLY" Steels Normalized or Liquid Quenched, Finish Machined and Flame Hardened.

	Ultimate Tensile Lbs. per Sq. In.	Elastic Limit or Yield Point Lbs. per Sq. In.	Elongation Percent	Reduction of Area Percent	Brinell	Sclero-scope
S.A.E. 1020 Case Hardened (Surface)...	260/300,000	180/195,000	5-10	8-12	514-601	71-81
S.A.E. 1020 Case Hardened (Core).....	60/ 70,000	30/ 35,000	30-35	40-50	120-140	17-20
Neloy Annealed and Flame Hardened Treatment 10B (Surface).....	218/270,000	190/240,000	8-12	20-35	477-590	66-80
Neloy Annealed and Flame Hardened Treatment 10B (Core).....	85/ 90,000	55/ 65,000	23-40	30-40	163-170	23-24
S.A.E. 1020 Case Hardened (Surface)...	260/300,000	180/195,000	5-10	8-12	514-601	71-81
S.A.E. 1020 Case Hardened (Core).....	60/ 70,000	30/ 35,000	30-35	40-50	120-140	17-20
Neloy Heat-treatments No. 3 and 10B (Surface).....	220/270,000	200/240,000	8-12	20-35	550-590	68-80
Neloy Heat-treatments No. 3 and 10B (Core).....	100/110,000	80/ 90,000	20-26	40-50	202-240	29-33
S.A.E. 2315 Case Hardened (Surface)...	290/329,000	185/205,000	4- 8	6-10	570-653	78-87
S.A.E. 2315 Case Hardened (Core).....	112/129,000	99/120,000	12-20	38-51	249-275	35-39
Neloy-Molybdenum, Normalized, Drawn and Flame Hardened (Surface)	258/281,000	212/247,000	6-10	8-12	514-555	71-75
Neloy-Molybdenum, Normalized, Drawn and Flame Hardened (Core)	90/110,000*	65/ 85,000*	18-25	30-40	190-220	28-33
S.A.E. 2315 Case Hardened (Surface)...	290/329,000	185/205,000	4- 8	6-10	570-653	78-87
S.A.E. 2315 Case Hardened (Core).....	112/129,000	99/120,000	12-20	38-51	249-275	35-39
Neloy-Molybdenum Heat-treatments 3A and 10B Flame Hardened (Surface)	282/318,000	217/265,000	4- 8	6-10	555-627	75-84
Neloy-Molybdenum Heat-treatments 3A and 10B Flame Hardened (Core)	132/150,000	120/135,000	10-18	25-35	290-320	41-45

*The variation in tensile and yield in the third table is due to the alloyed elements of 2315 which is a nickel steel. This produces a higher physical on a straight annealed steel compared with more economical alloy used in Neloy Moly.

NATIONAL ERIE CORPORATION

ERIE, PENNSYLVANIA • U. S. A.

NE

PLATE HANDLING CRANES

When your Plate Handling Cranes are "Shaw-Box," you utilize all the reliability, efficiency, and service that these cranes are known for throughout the steel industry. Plate Handling Cranes are a specialty with us, growing through years of study and field experience in designing and producing this type of equipment to fully meet the most severe and exacting mill service specifications.

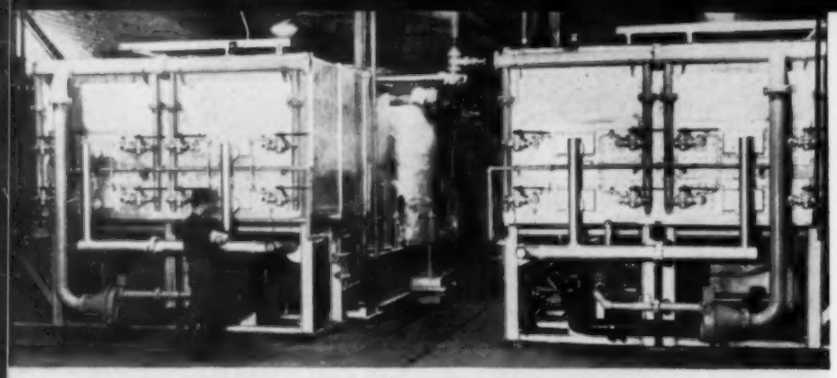
Specialization in pioneering, designing, and producing Plate Handling Cranes has long been a "Shaw-Box" tradition. Working hand in glove with the steel industry, "Shaw-Box" research men and engineers have gained the intimate understanding of plate handling requirements that has developed features such as variable flux control — lifting magnets that discharge one plate at a time after picking up several — rope lifts instead of bars, with guides to restrict swing — and many other advantages for faster, dependable operation.

Even with these special features, engineering, construction, and design expense involved in building "Shaw-Box" Plate Handling Cranes is exceptionally low.

Be sure to send all your inquiries and specifications for Plate Handling Cranes and Gantries to "Shaw-Box."

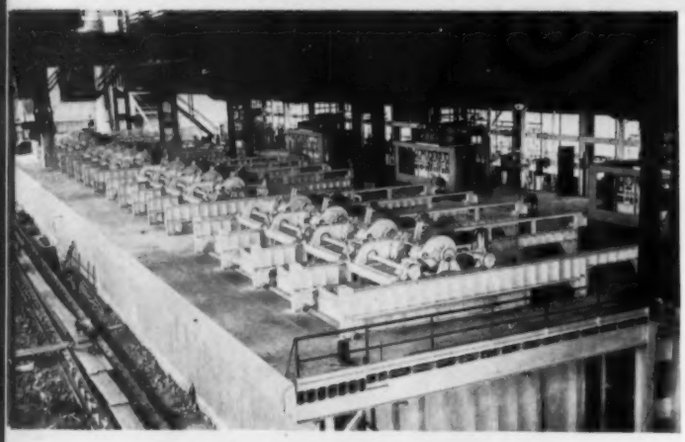
MANNING, MAXWELL & MOORE, INC.
SHAW-BOX CRANE & HOIST DIVISION
MUSKEGON, MICHIGAN

dependable, economical

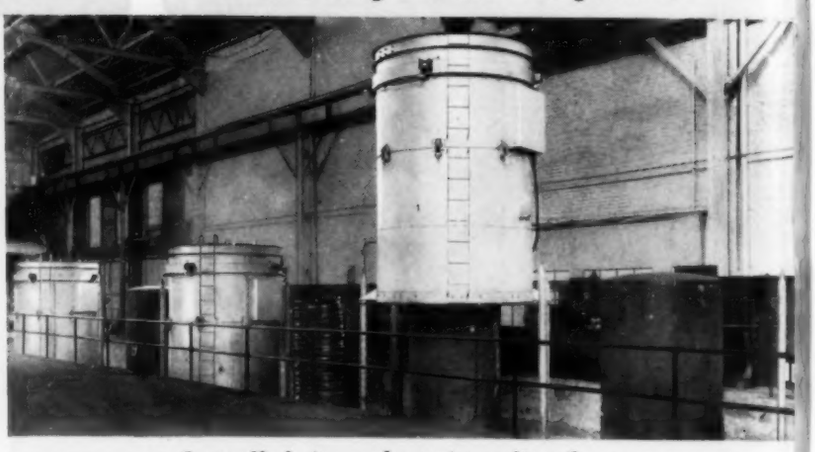


Prepared Gas Atmosphere Generating Equipment {RX, AX, NX, DX, HNX, and Char-Mo Gases}

Continuous-type, Controlled Atmosphere Strip Annealing and Normalizing Furnaces

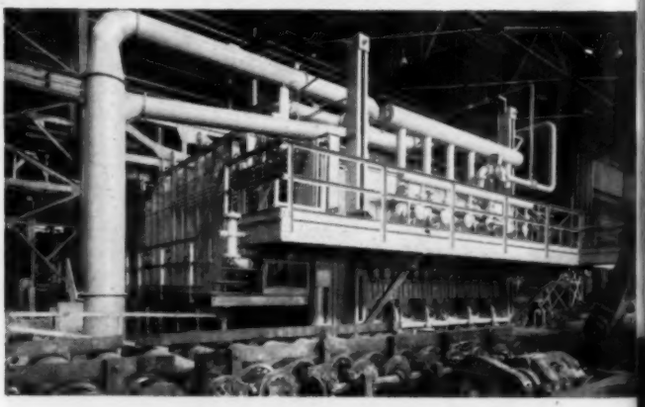


One-Way Fired Soaking Pits



Controlled Atmosphere Annealing Covers for wire and rod

Continuous Furnaces for heat treating of steel plate



Slab Heating Furnace

'Surface' SERVES THE STEEL INDUSTRY

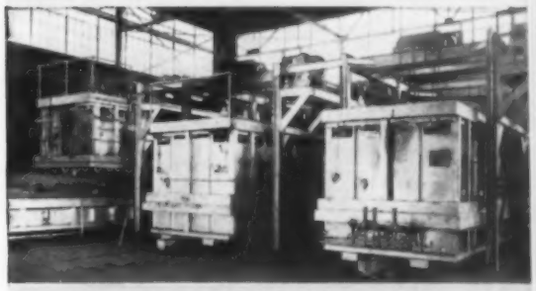
heat

FROM INGOT THROUGH FINISHED PRODUCT

'Surface' research, development and scientific application of prepared gases, heat and mechanisms to the many heating problems in the metal producing and working industries, year-after-year, has resulted in modern heating equipment with a proved background of dependability and economy.

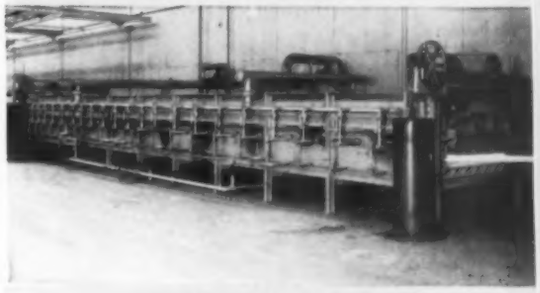
Herewith are a few such heating installations representative of the many ways that 'Surface' *serves the steel industry.*

Billet Reheating Furnace

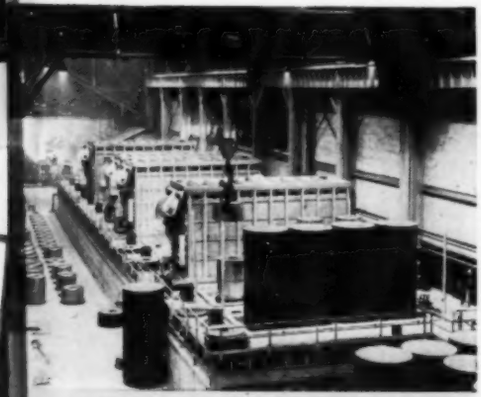


Controlled Atmosphere Furnace for carbon correction in high alloy rod and bar stock

Continuous-type Bright Annealing and Normalizing Furnace



Wire Patenting Furnace



Controlled Atmosphere Annealing Covers for coil and sheets

Rod Annealing in Pit-type Convection Furnaces

Stress Relief Furnace

SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

FOREIGN AFFILIATE COMPANIES

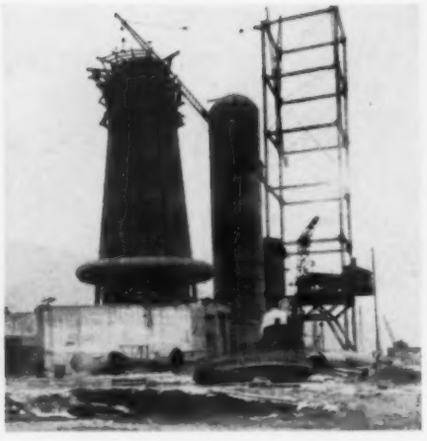
BRITISH FURNACES LIMITED—CHESTERFIELD
STEIN & ATKINSON, LTD.—LONDON
STEIN & ROUBAIX—PARIS, LIEGE AND GENOA
WILL I. SMITH S.A.—BUENOS AIRES

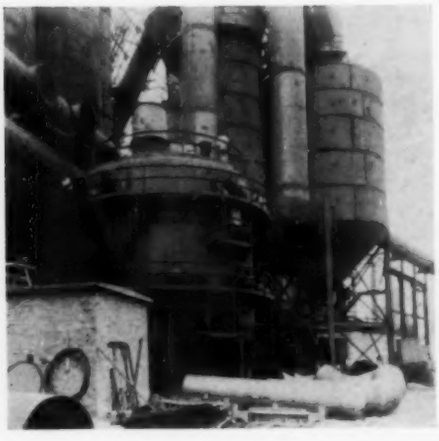
PENNSYLVANIA ENGINEERING CORP.

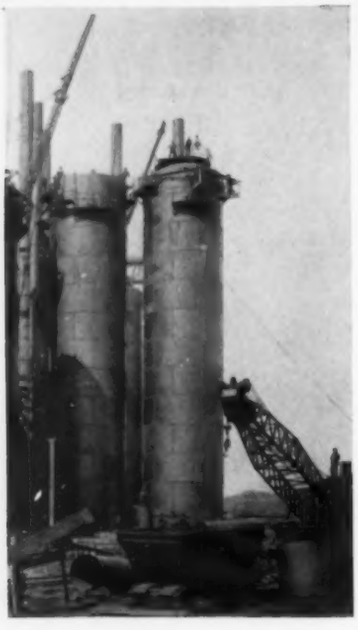
NEW CASTLE, PENNA.

Engineers - Contractors - Erectors

Builders of Blast Furnace and Blast Furnace Equipment





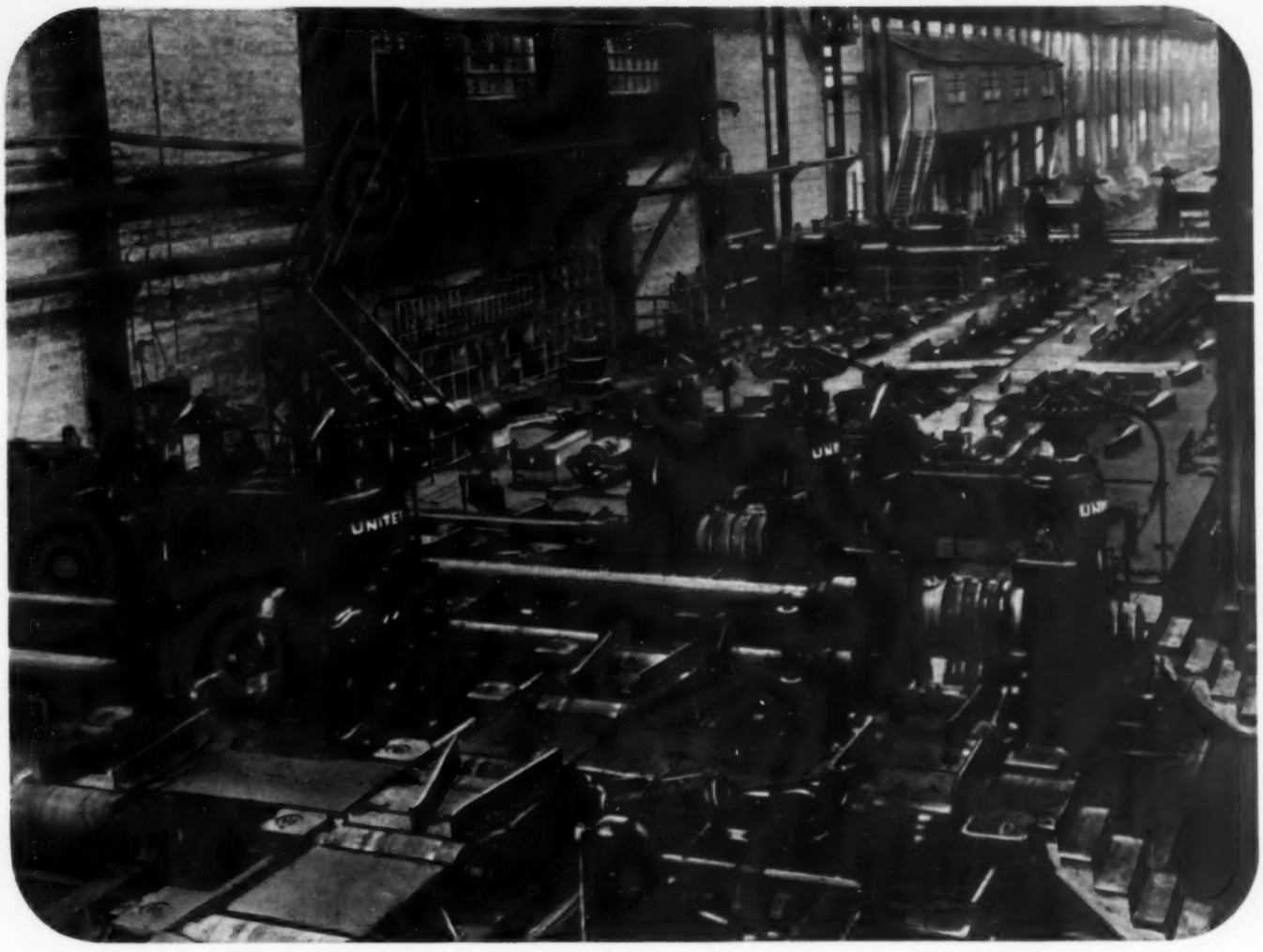


Skip Cars
Skip Inclines
Cast Houses
Ore Bins
Gas Mains
Blast Mains
Columns
Valves
Burners
Hot Metal Cars
Cinder Cars

Blast Furnaces Repaired, Dismantled, Enlarged, Modernized

Complete facilities within our own organization enable us to give prompt and efficient service. In addition to our engineering and erecting department, our facilities include a machine shop, plate shop, structural shop, welding shop, forge shop and pattern shop.

Bells
Hoppers
Furnace Shells
Bustle Pipes
Tuyere Jackets
Bosh Bands
Hot Blast Stoves
Stove Fittings
Hearth Jackets
Dust Catchers
Gas Washers



24" BILLET MILLS

Designed and built by **UNITED**

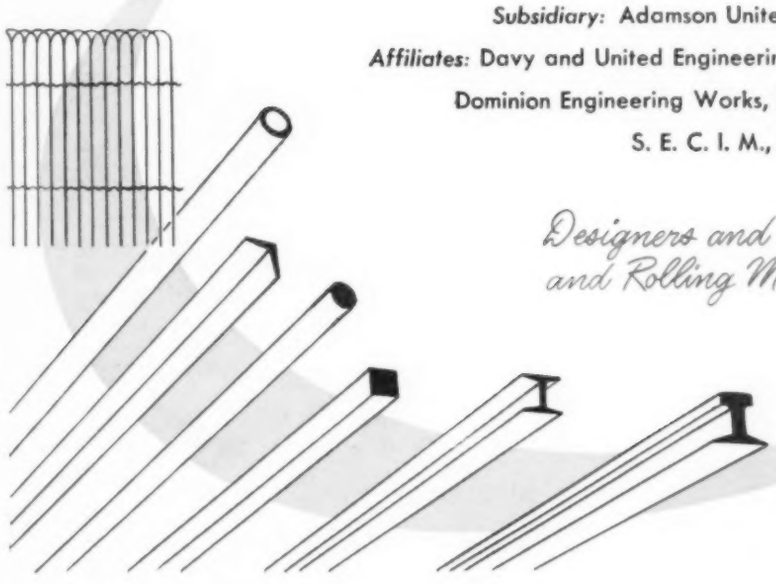
ENGINEERING AND FOUNDRY COMPANY

Pittsburgh, Pennsylvania

Subsidiary: Adamson United Company, Akron, Ohio.

Affiliates: Davy and United Engineering Company, Ltd., Sheffield, England;
Dominion Engineering Works, Ltd., Montreal P. Q. Canada;
S. E. C. I. M., Paris, France

Designers and Makers of Rolls and Rolling Mill Equipment

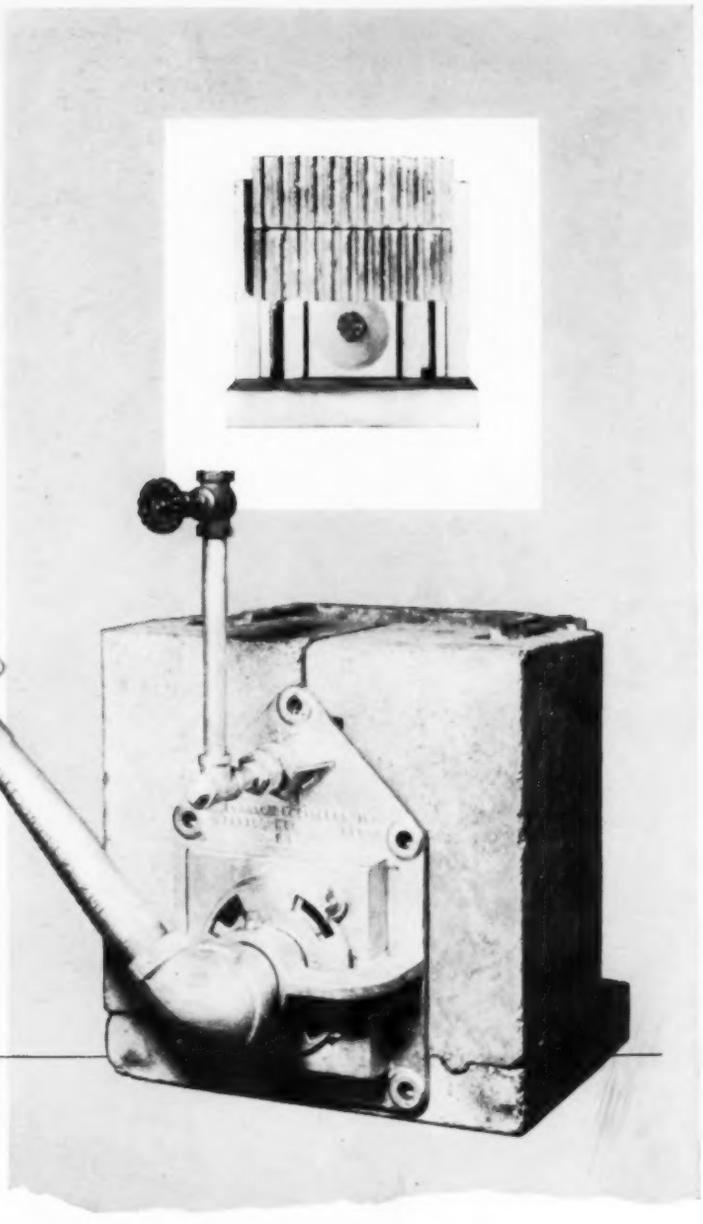


REG. T. M.

TO CUT YOUR
HEAT TREATING
COSTS . . . .

F.E.I. offers

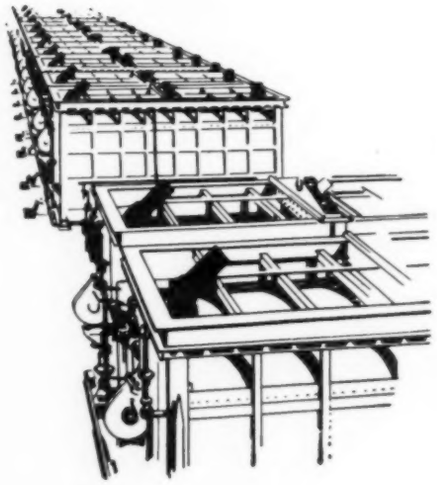
extreme
burner
flexibility



Whether your heat treating requires a neutral, oxidizing or reducing atmosphere, F. E. I. burners will reduce your costs and maintain quality. These burners possess extremely high up-turns and very low turn-downs, enabling each burner to follow exactly the demand of the controls.

F. E. I. burners furnish both high maximum input and the ability to maintain combustion at the lowest possible capacity when needed. Thus you completely eliminate the need of shutting off burners during idling periods. F. E. I. burners will meet the requirements of every stage of your heating cycle. They will operate with equal efficiency at high or low pressure. They will burn any gaseous fuel—be it butane gas, propane, natural, oil refinery, coke oven gas, blue gas, clean producer gas and clean blast furnace gas.

F. E. I. will be glad to furnish detailed information on the cost-saving efficiency of these burners upon request. There is no obligation.



FURNACE ENGINEERS, INC.

1552 WEST LIBERTY AVE. • PITTSBURGH 22, PA.

*PENETRATION

Peak production . . . without worry of breakdown due to friction and wear . . . is made easier with Tycol high quality greases.

Made to "absorb punishment" without thinning down and dripping, Tycol greases avoid wasted lubricant, lost bearings and unnecessary down-time. These ultra-safe lubricants keep bearings . . . gears . . . shafts . . . friction-free and cool. They are available in grades with the proper "*PENETRATION" needed to give power a chance to produce with a minimum of waste.

Call your nearest Tide Water Associated office. Let them suggest the Tycol grease best suited to your needs . . . and remember, Tycol green cast greases are made from high quality cylinder stock and well refined neutral oil, with a minimum of soap — a maximum of oil . . . more efficient lubrication per pound of grease.

TYCOL
INDUSTRIAL LUBRICANTS

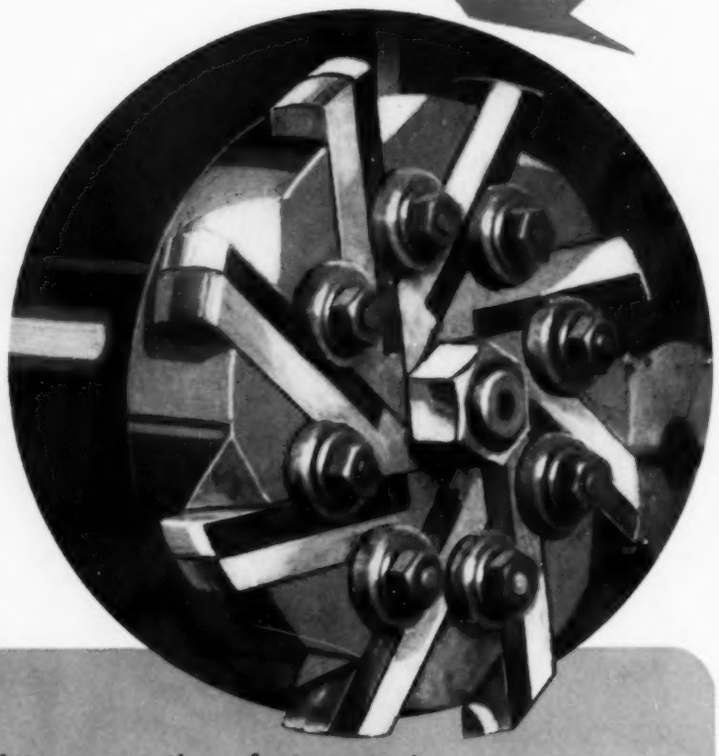
Boston • Charlotte, N. C. • Pittsburgh • Philadelphia • Chicago Detroit • Tulsa • Cleveland San Francisco • Toronto, Canada

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE - NEW YORK 4, N.Y.

***LEARN WHAT THIS PRODUCT CHARACTERISTIC MEANS TO YOU — READ "LUBRICANIA"** This informative handbook, "Tide Water Associated Lubricania," gives clear, concise descriptions of the basic tests used to determine important properties of oils and greases. For your free copy, write to Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

REFINERS AND MARKETERS OF VEEDOL — THE WORLD'S MOST FAMOUS MOTOR OIL

As the alloy-steel teeth of the cutting head of the Bonnot Billeteer "bite" into bad billets, they also *"bite" into billet-conditioning costs as deeply as 56%.* Such savings are conclusively proven in cost studies covering the reconditioning of 25,000 tons of billets.



And here are other savings from Billeteer operation—features not available in any other billet conditioning method:

Saves **REMELTING** of billets—normally not salvageable—by biting out all defects, even those inches in depth. Inventory of billets can therefore be reduced to a minimum.

Saves **SCRAP**—tons of clean chips of known analysis each day ready for remelt usage.

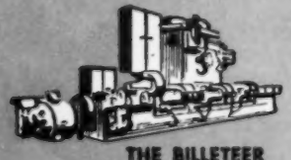
Saves **PRODUCTION SCHEDULES** because the Billeteer works dependably, shift after shift, day after day—some units with service records of 80,000—90,000—100,000 hours each.

Saves **WORKER EFFICIENCY**—the 45-ton machine responds — instantly and smoothly—to finger-tip control, reducing fatigue, illness, accidents and physical drag which result from worker exhaustion in "more muscular methods"

Write today for full information.

Engineered for Improved Production

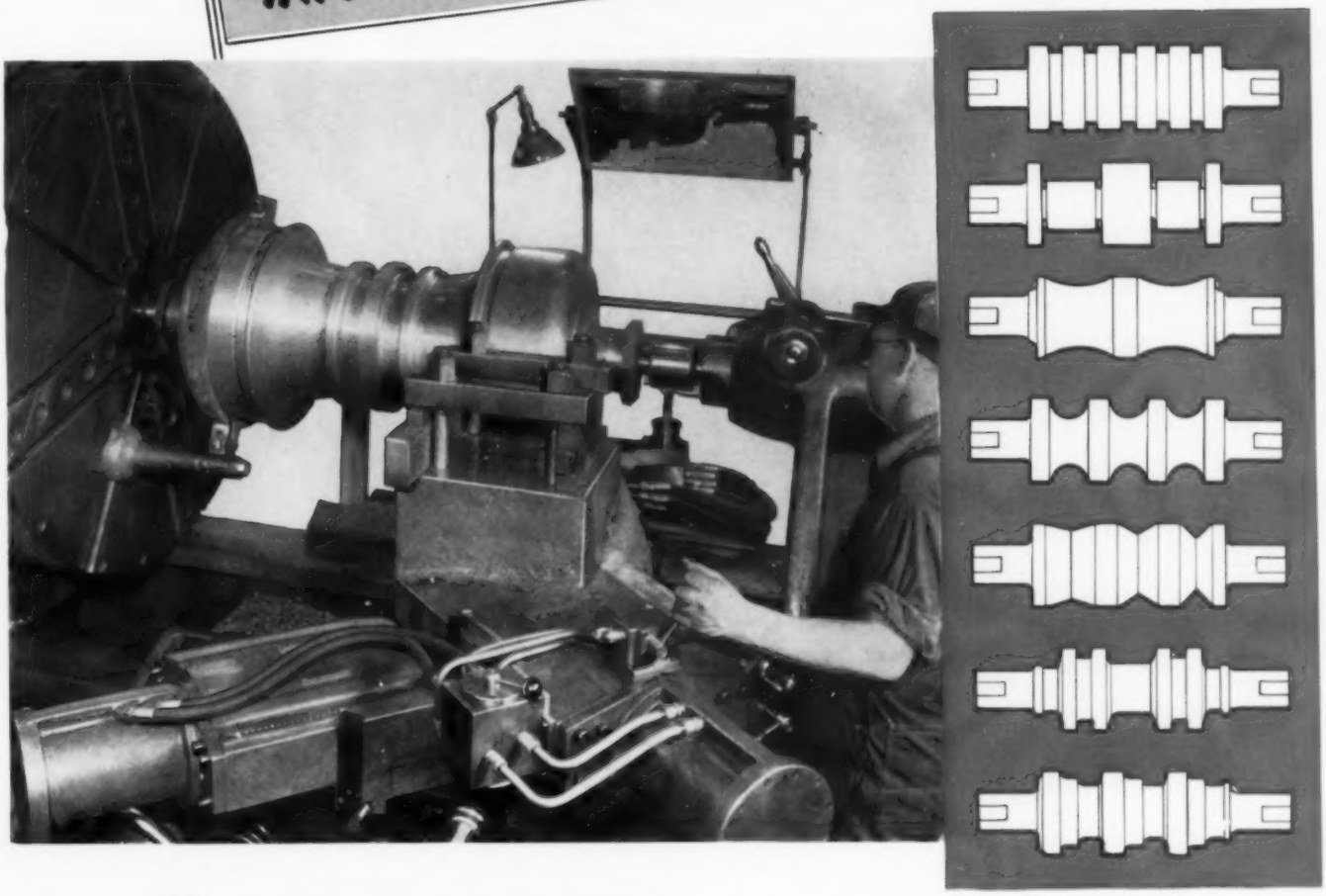
The Bonnot Co.
STEEL EQUIPMENT DIVISION
CANTON 2, OHIO



THE BILLETEER

ALSO MANUFACTURERS OF SAWING • CRUSHING • PULVERIZING & MIXING EQUIPMENT
BILLET INSPECTION TABLES • DUST PUG MILLS • SINTER PLANT PUG MILLS

ANOTHER TURCHAN FIRST!



Turning of mill rolls by tracer control saves up to 100% in production time

Your present lathes when equipped with the new Turchan Dual Turning Follower can revolutionize production of steel mill rolls. No more need for specially built machines and costly form tools. No special training of men is required. Job set-up is reduced to a fraction of former time.

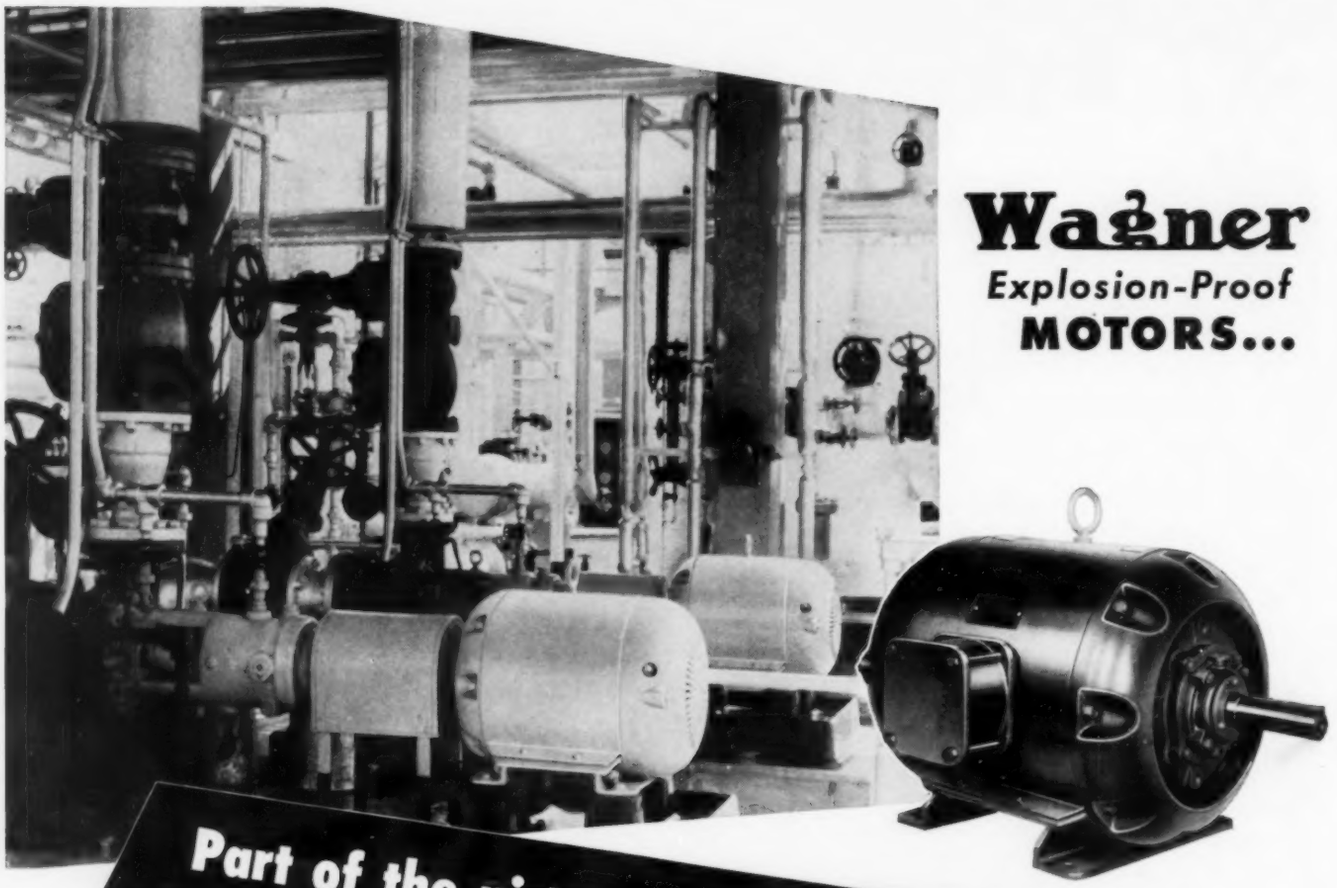
Contours are generated from a template by means of a hydraulically controlled cutting tool. The cross slide is equipped with 2 compounds mounted at 45° to center line and 90° to each other, replacing the conventional slide. This creates a **new combination** of movements. Now, for the first time, with the Turchan Dual Turning Follower, tool approach to the work is **doubled.** Any shape on left or right of center, or on the face, or a combination of both, can be machined with the simplicity of straight work.

Greater accuracies are possible due to increased rigidity of operation, as the work piece is mounted between journals, and tracer movements of cross slide are independent of mechanical movements of carriage. This is especially important in slight motion as the cutting tool responds quickly and accurately, giving a smooth, stepless finish. Size of work is limited only by the capacity of the machine. There is a Turchan Follower attachment for any standard lathe; also for milling machines, planers, shapers and grinders — tool room or mass production work. **"Turn to Turchan" for greater profits!**

WRITE US TODAY: Send a sketch and specifications of any roll job. Give make of machine. We'll show you how to produce it better, faster, at lower cost.

Turchan **FOLLOWER MACHINE COMPANY** 8259 LIVERNOIS AVENUE DETROIT 4, MICH.

Oldest Manufacturer of Hydraulic Duplicating Attachments for Machine Tools



Wagner
Explosion-Proof MOTORS...

Part of the picture... Where Safety Counts

You'll find thousands of Wagner type HP Motors on the job where explosive atmospheres are present. There's a mighty good reason—the Wagner type HP Explosion-Proof Motor is specifically designed to operate economically and *safely* in surroundings where open type motors are hazardous. It has been fully tested and approved by Underwriters' Laboratories for Class I Group D hazardous locations.

But meeting Underwriters' standards is not the only factor considered in the building of these motors—they are designed by Wagner to give many years of dependable, troublefree service under the most severe operating conditions.

If the atmosphere in your plant contains explosive gases, fumes, vapors or combustible substances, investigate the safety and long service qualities of Wagner type HP Motors.

Twenty-nine branch offices, located in principal cities, are ready to help you whenever you have a motor problem. Users of Wagner Motors also profit by nationwide service facilities. Write for Bulletin MU-185 for information on the complete line of Wagner Motors.

Wagner Electric Corporation

6483 PLYMOUTH AVE., ST. LOUIS 14, MO., U. S. A.

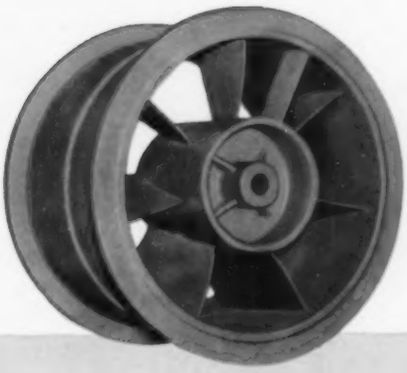
Consult Wagner Engineers on all Electric Motor Problems

M49-20A

BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

ELECTRICAL EQUIPMENT AND AUTOMOTIVE BRAKE PRODUCTS

ACCURACY



STRENGTH

WEAR RESISTANCE

What *Qualities* do you look for in Non-Ferrous BEARINGS and CASTINGS?

You want ALL FOUR, of course . . . and you get ALL FOUR qualities plus better performance and greater long-range economy when you specify N-B-M Bearings and Castings.

SHOCK RESISTANCE

The bearings and castings shown above are typical results of these complete—and modern—facilities that you'll find at National Bearing Division:

Research—

American Brake Shoe's extensive research labs, containing the latest in testing equipment, are always at the disposal of N-B-M for all types of research on customers' problems.

Engineering—

The N-B-M Engineering staff is fully qualified to work either for or with you in solving problems of stress, alloy or over-all design of bearings and castings.

Production—

From precision molding to final machining, N-B-M has the latest manufacturing techniques that assure you of products with maximum strength, precision, wear-resistance and density.

Quality Control—

Modern X-Ray, Photomicrographing equipment, and other latest testing devices provide a surety for you of castings that meet and often exceed your specifications.

Yes, if qualities that insure longer, more economical service are important for the Bearings and Castings used in your plant or product, call in your nearest N-B-M Representative. He will be glad to give you specific information on how this complete N-B-M service can be applied to your problems.

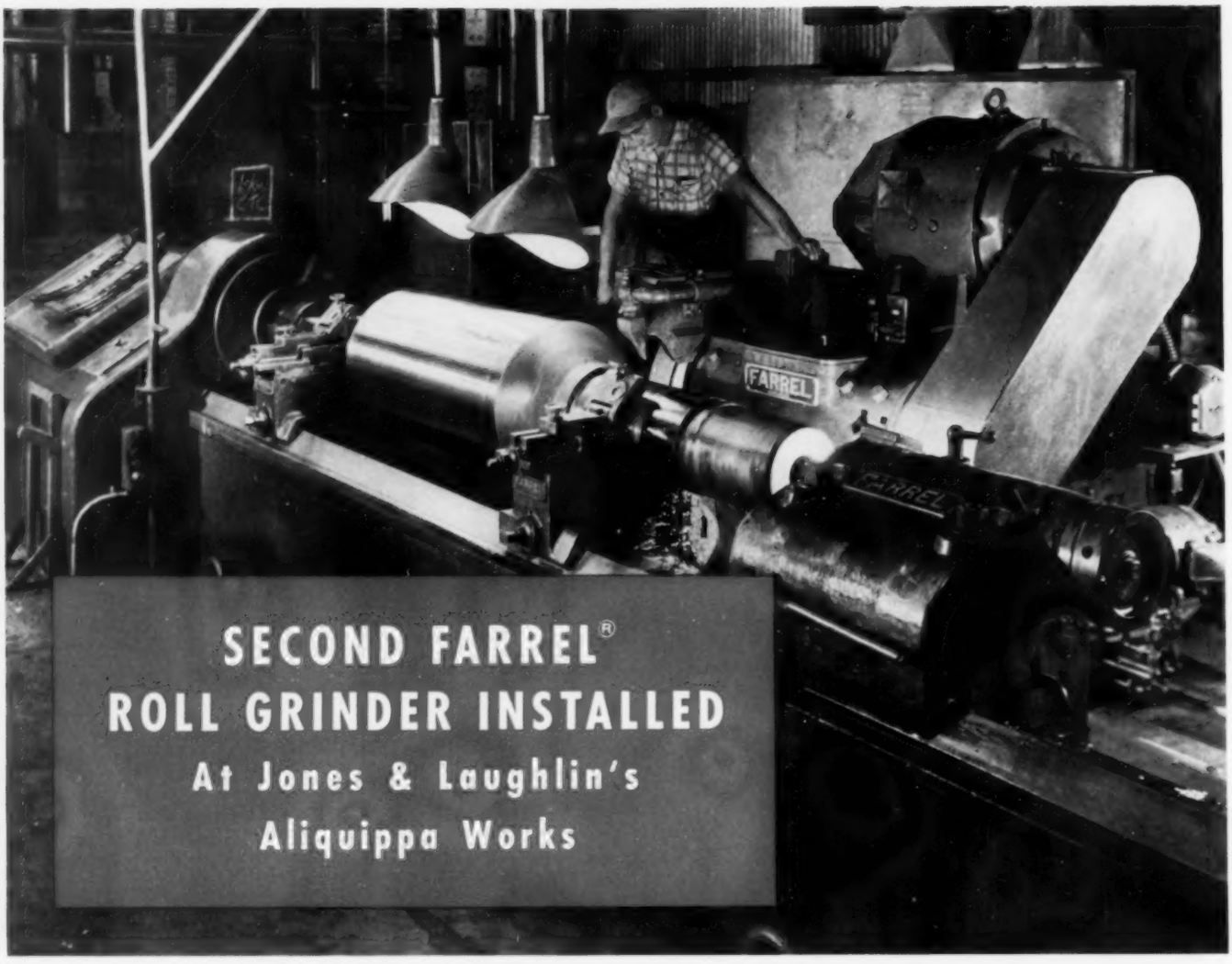
N·B·M

AMERICAN Brake Shoe COMPANY

NATIONAL BEARING DIVISION

ST. LOUIS 10, MO. • MEADVILLE, PA.

PLANTS IN: ST. LOUIS, MO. • MEADVILLE, PA. • NILES, OHIO • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.



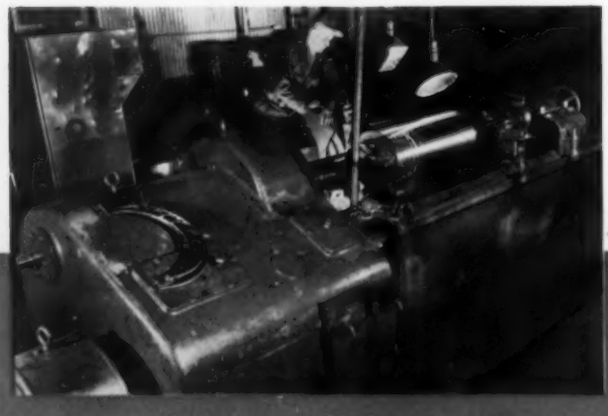
SECOND FARREL® ROLL GRINDER INSTALLED

At Jones & Laughlin's Aliquippa Works

In 1941, a Farrel 28" x 14'0" Heavy Duty Roll Grinder was installed at the Aliquippa Works of Jones & Laughlin Steel Corporation. Then – typical of the many users of these machines – a second machine was purchased when production requirements increased.

The key to the many repeat orders for Farrel grinders is found in reports from users. These reports indicate that with the latest type machines, roll grinding time can be cut substantially. At the same time, rolls are obtained with a perfect surface free from marks of any kind, either straight or with concave or convex contours ground to exact symmetry and accuracy. Faster grinding means increased productive capacity of the machine and lower labor cost per roll ground.

Write for Bulletin No. 115 which describes in detail the many features of the Farrel Heavy Duty Roll Grinder. A copy of this 28-page bulletin will be sent to you without cost or obligation.



FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Los Angeles, Houston

FB-555

Farrel-Birmingham®

Meet Joe Garlic

(who has troubles)

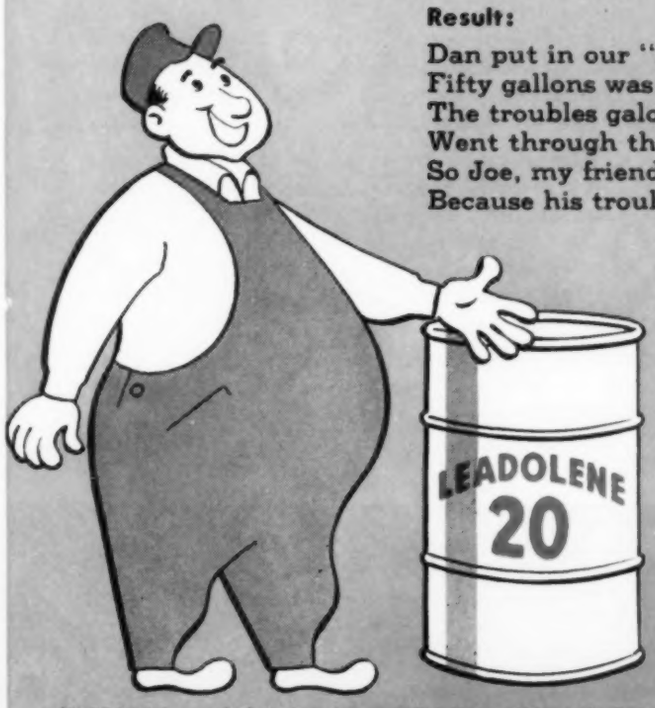
A Master Mechanic by the name of Joe Garlic,
Got white headed when he thought of Hydraulic,
He pulled out his hair and got even colic,
Alas, it got so he couldn't even frolic.

"My pumps have the mumps,
Even the packing is lacking,
The action is only a fraction,
The vanes are wearing in vain.
Gosh! Even the sludge I cannot budge."

Then it would seem Joe heard of Leadolene,
So he called in "Our Dan"
and said, "My Good Man,
It's help I need, as quick as you can."

Result:

Dan put in our "20",
Fifty gallons was plenty.
The troubles galore
Went through the floor,
So Joe, my friend, is on the mend
Because his troubles have come to an end.



The moral:

LEADOLENE will solve most any Hydraulic trouble.

"LEADOLENE . . . the" "I.P. Lubricant" ("Indestructible pH-ilm") . . . for Industrial Needs

The Brooks Oil Co.

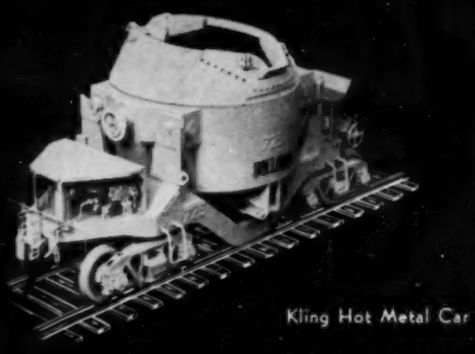
Pittsburgh 12, Pennsylvania
Cleveland, Ohio
Hamilton, Ontario

Warehouses: In Principal Industrial Cities

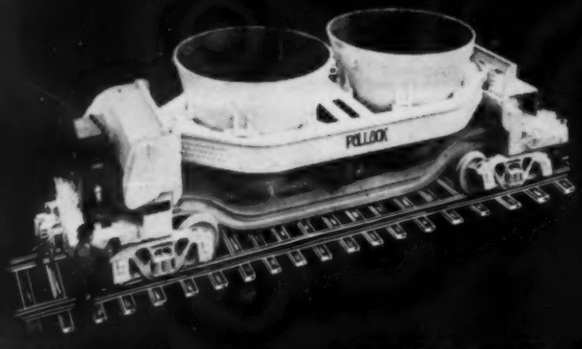
BLAST FURNACE CARS FOR THE IRON AND STEEL INDUSTRY . . .

POLLOCK

BUILDS ALL TYPES

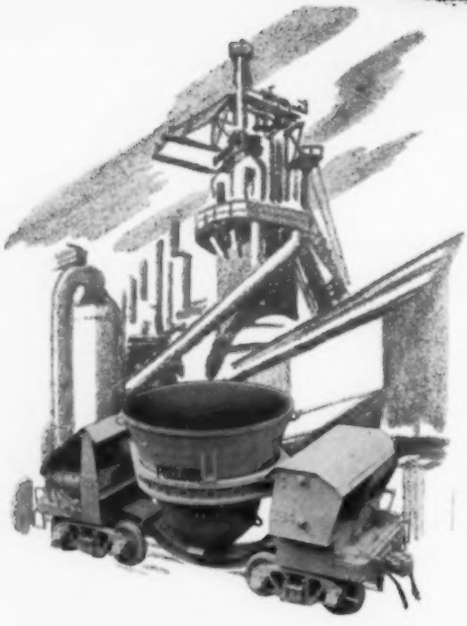


Kling Hot Metal Car



Double Pot Cinder Car

Open-Top Hot Metal Car



● **POLLOCK hot metal cars** are equipped with demountable ladles, standard or "tailor-made" to meet your individual needs—in any capacity up to 100 tons—and these can be made even larger, depending on railroad clearances. The car bodies are of welded steel construction, either all-welded in one piece, or with end and side frames bolted together to save space in shipping. Both Kling and Open-Top types can be supplied for long pouring or short pouring.

POLLOCK cinder cars, made for air, steam, or electric operation, are sturdily built of all-rolled welded steel construction, with pots of capacities up to 400 cubic feet each. Operating equipment can be arranged to dump from either side, and trucks have A. A. R. standard wheels, axles, bearing brasses and springs. Special end-thrust bearings or roller bearings of your choice can be provided.

Let Pollock's expert engineers make a study of your hot metal and cinder handling requirements, and recommend the blast furnace car equipment best suited to your plant. ○

POLLOCK

THE WILLIAM B. POLLOCK COMPANY

YOUNGSTOWN · OHIO

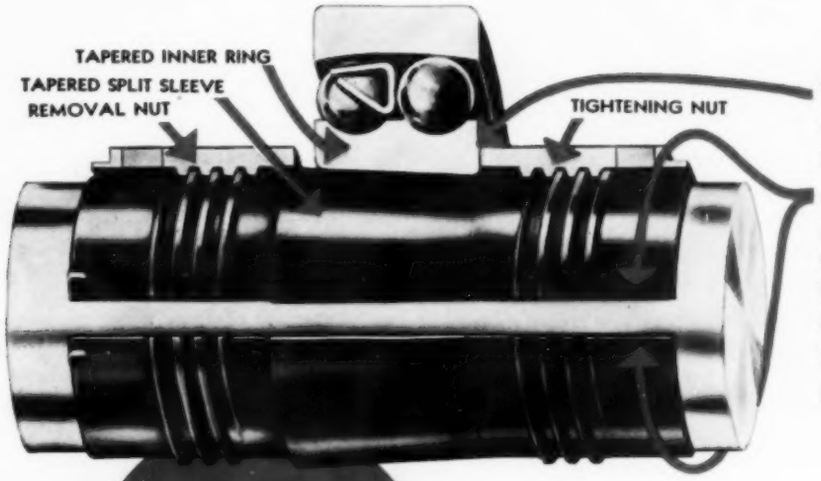
STEEL PLATE CONSTRUCTION · ENGINEERS · FABRICATORS · ERECTORS

BLAST FURNACES · HOT METAL CARS AND LADLES · CINDER AND SLAG CARS · INGOT MOULD CARS · CHARGING BOX CARS · WELDED OPEN HEARTH LADLES

SOMETHING NEW!

SKF introduces the SUA UNIT PILLOW BLOCK featuring a tight fit between bearing and shaft

Here's How It Works



TIGHT FIT results when the tightening nut pushes the tapered inner ring over the tapered split sleeve.

CONCENTRIC GRIP is firm and positive—as the split sleeve contracts and wraps around the shaft. Removal is accomplished by reversing the process—with tightening nut loosened, removal nut pushes inner ring off the sleeve.

ON or OFF *in a few seconds*

The *new* SKF SUA Unit Pillow Block is completely assembled, lubricated and ready for immediate use. Available in "free" or "held" types and in shaft sizes from $1\frac{7}{16}$" to $2\frac{7}{16}$".

Its SKF-exclusive Align-O-Seals prevent lubricant leakage and dirt intrusion. Designated as type SUA with ball bearings—and type SUAR with spherical roller bearings.

No exposed bearing . . . no lock screws to raise troublesome burrs on the shaft . . . the nut is locked to the sleeve . . . and even though the shaft vibrates, the concentric grip will not loosen.

For more information, check your local authorized SKF Distributor, or write: SKF Industries, Inc., Philadelphia 32, Pa. 6681

Bearings and pillow blocks engineered by **SKF**

Cold-rolling crown-rolled strip accurately, in Bliss 3 stand, 2-high mill.

How BLISS Put Extreme Capacities into a Precision Mill

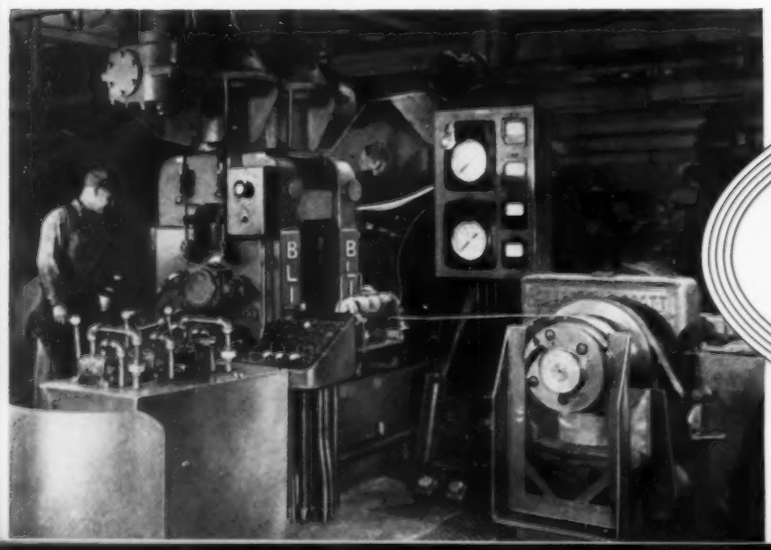
HERE'S THE RECORD of this 3 stand, 2-high mill engineered and built by Bliss for a leading steel producer.

A 50% average reduction in a single pass; accurate cold-rolling and finishing of stainless and special alloys within .001″ overall; round-the-clock operation, week in, week out, at speeds up to 600 ft. per minute.

Controlled tension on pay-off reel and precision machining of all fitted parts—all work for the utmost in accuracy. Sturdy construction throughout guards its precision at extreme capacities. From the roller's control panel, there's coarse and fine rheostat control for instantaneous adjustment of tension, and special bearing pressure gages and controls to minimize bearing wear and roll-neck stresses. A special speed control holds size while reducing speed.

Here's another case example of how Bliss engineering works to improve the rolling of hot and cold rolled strip to rigid specifications. Bliss builds a complete line of rolling mill equipment: 2-, 3-, and 4-high mills for ferrous and non-ferrous metals, single stand reversing or tandem operation, cluster mills and complete accessories.

For maximum rolling mill efficiency, it will pay you to put your problem up to Bliss. A trained sales engineer will go into it thoroughly with you.



One of two new Bliss 2-high mills for temper rolling installed in the same plant.

E. W. Bliss Company

General Office: Toledo 7, Ohio

Rolling Mill Division

Salem, Ohio

Johns-Manville

Announces...

...sets a new high of 3000 F for insulating fire brick service

● Here is a new insulating fire brick, especially developed by the Johns-Manville Research Laboratory for use in forge furnaces, ceramic kilns, chemical process furnaces and other types of high-temperature equipment operating above the previous range of insulating fire brick.

Some of the more outstanding advantages of JM-3000 Insulating Fire Brick are: It is the highest temperature insulating fire brick made for backup or exposed use, effectively withstanding the full 3000 F. Its efficiency remains at a high level throughout the life of the brick. It has exceptional service advantages in many operations at lower temperatures where regular or special fire brick is ordinarily used.

With its combination of outstanding insulating and refractory properties, JM-3000 Insulating Fire Brick has been found to provide longer life, greater fuel economy and important savings in downtime. For further information, write to Johns-Manville, Box 290, New York 16, N. Y.

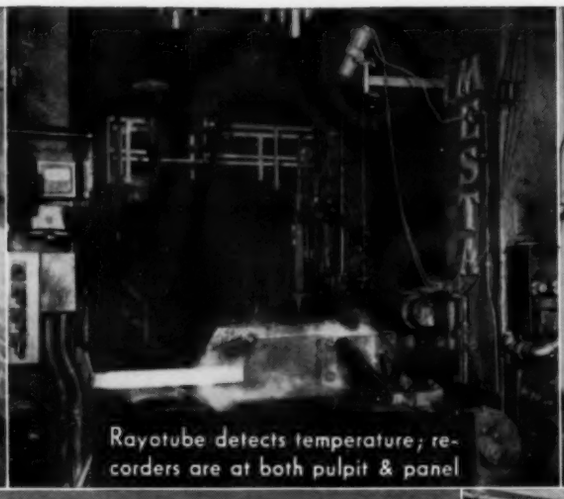
PHYSICAL AND THERMAL PROPERTIES

Molded from high quality kaolin clays plus alumina
Density—63-67 lb per cu ft
Modulus of rupture—200 lb per sq in.
Linear shrinkage—(24 hr Panel test @ 3000 F) .8 per cent
Linear thermal expansion to 2000 F—.5 to .6 per cent
Pyrometric cone equiv.—Cone 37+ (3308 F+)
Temperature limit—3000 F
Conductivity (Btu in. per sq ft per F per hr at mean temp)

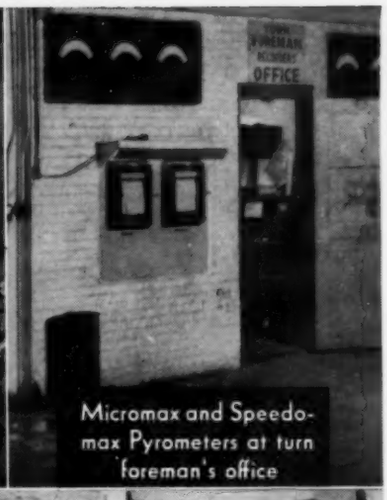
F	500	1000	1500	2000
Btu	3.10	3.20	3.35	3.60

Johns-Manville *First in* INSULATIONS

Hot Blast Control Unit located at valves remote from Recorder

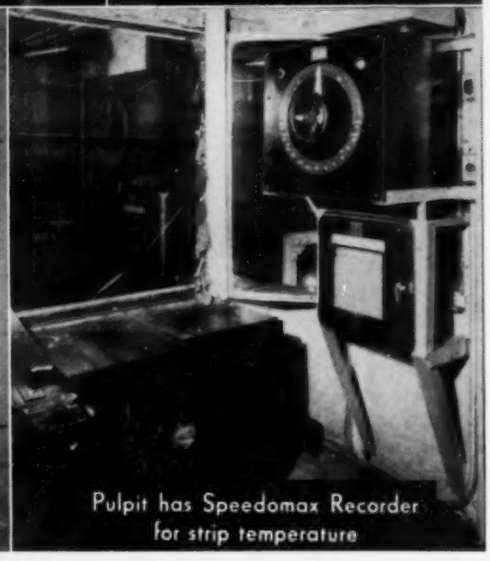


Rayotube detects temperature; recorders are at both pulpit & panel



Micromax and Speedomax Pyrometers at turn foreman's office

Hydrogen in anneal furnace atmosphere dependably recorded by Micromax instruments



Pulpit has Speedomax Recorder for strip temperature

FROM *ORE,* TO *STRIP,* TO *ANNEAL*

L&N HELPS INCREASE STEEL PRODUCTION

"Production and more production is our need. How can instruments help increase our output?"

Steel mill engineers who are asking that question of course already use hundreds of instruments to help production. A very few of these applications, old and new, are shown above.

One of the newer developments is *multiple* recording of temperatures of sheet, strip, etc. A *single* Rayotube detects the temperature of the moving steel; it is connected to *two* Speedomax Recorders — one in the pulpit, the other at the instrument panel. Thus both the roller and the turn foreman are equally and simultaneously informed of this production-influencing temperature.

Another recent innovation uses Micromax Recorders to show the percent hydrogen in the manufactured protective atmospheres of annealing cover furnaces. These Recorders help substantially to anneal at maximum speed.

Complete, integrated Temperature-Pressure-Combustion Control for all the larger furnaces minimizes or prevents time-wasting temperature swings, gives control of scaling, and enables any scheduled changes in temperature to be made in minimum time. By assuring correctness in both temperature and furnace atmosphere, it speeds production.

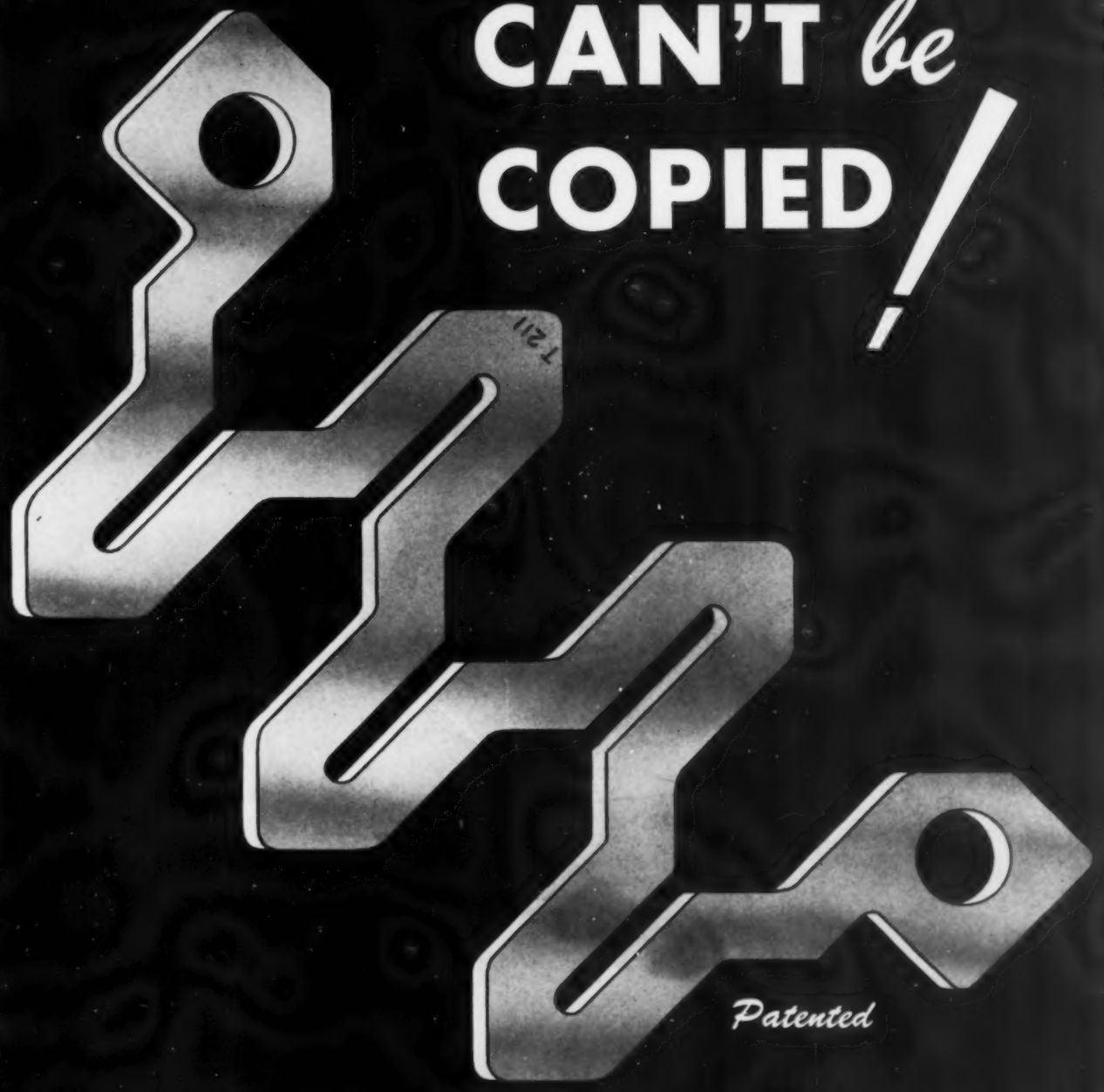
All L&N equipment ranks high in what some mill men call "percent availability." It stays in service, dependably; all the way from blast furnace to finishing mills. We will be glad to give details — either by catalog or in person, as you prefer. Write Leeds & Northrup Co., 4942 Stenton Ave., Philadelphia 44, Pa.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jrl Ad ND4-33-600(1)

THE *Shape...* CAN'T *be* COPIED!



Patented

The Nonbreakable Steel Grid Resistor

Shown here is a 250-ton push-pull, screw-type Stripper crane, used for stripping both small end-up ingots, and large end-up ingots with hot tops. An added feature for faster handling is the retractable bull nose; with this, no adjustments are necessary when stripping ingots of various types and sizes. Alliance builds this Stripper crane in various capacities up to 800 tons, with a safety factor of 5. If your installation does not warrant a stripper of this kind, ask us about our impact stripper, which makes use of the most reliable of all forces, gravity. The Alliance Machine Company builds all types—all sizes—to move heavy loads safely, quickly, economically. Always rely on Alliance to give your plant dependable, extra lifting power.

BIG
CRANES

THE ALLIANCE MACHINE COMPANY

MAIN OFFICE
ALLIANCE, OHIO

PITTSBURGH OFFICE
1622 OLIVER BUILDING, PITTSBURGH, PA.

LADLE CRANES • GANTRY CRANES • FORGING MANIPULATORS • SOAKING PIT CRANES
STRIPPER CRANES • SLAB AND BILLET CHARGING MACHINES • OPEN HEARTH
CHARGING MACHINES • SPECIAL MILL MACHINERY • STRUCTURAL FABRICATION

ASKANIA Controls

KNOWN THE WORLD OVER AS THE FINEST PRECISION CONTROLS

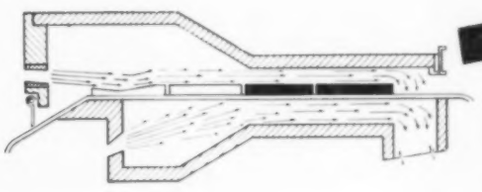
Askania Pressure Regulation system in an enclosed Panel Board.

FURNACE PRESSURE REGULATORS are an excellent example of why Askania Controls are being specified in increasing numbers in plants throughout the world. Askania Regulators maintain the proper furnace pressure for uniform heating in accordance with the most economical relation between fuel consumption and furnace maintenance, as indicated in the diagrams below.

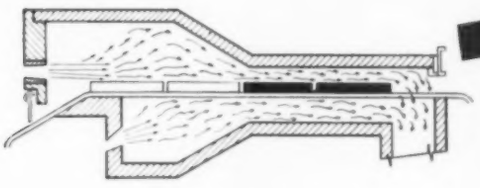
The control mechanism is simple, accurate, practical and dependable, designed by Askania Engineers after years of research and development. Operating on the exclusive Askania Jet Pipe Principle the Regulator provides precise, automatic adjustment of a flue, damper or fan speed for maintaining control.

Regardless of your control problem, whether it concerns pressure, flow or proportioning, there are Askania Controls to meet your requirements. What is your problem?

Interior, showing mounting of Pressure Regulator.



Arrows indicate effect of negative furnace pressure on flame velocity and direction.



Flames travel through furnace operating at correct furnace pressure.

Jet Pipe Principle . . .

Exclusive Askania Jet Pipe Engineering Principle, a simple, sensitive, accurate means for amplifying a minute signal into a powerful force to operate a valve, damper or other mechanism. The Jet Pipe is the heart of all Askania Controls.

SEND FOR BULLETIN 139

ASKANIA Controls

ASKANIA REGULATOR COMPANY

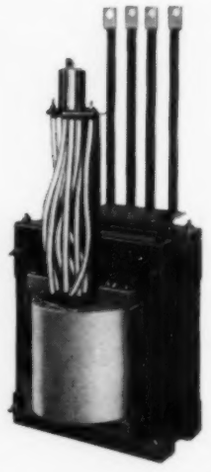
A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORP.

240 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS

Better... Lighter Weight... Smaller... More Efficient... Less Costly to Store... Easier to Install

4 NEW PENNSYLVANIA POLE STAR TRANSFORMERS

37½ · 50 · 75 · 100 KVA



Interior assembly of 75 Kva POLE STAR. Core can be taken apart and rebuilt without changing the core loss or exciting current.

The new 100 KVA POLE STAR TRANSFORMER

is **35%** *lighter*

requires **36½%** *less oil*

covers **35½%** *less floor area*

than the 100 KVA Stacked Core Transformer it replaces

Now a COMPLETE LINE OF POLE STARS from 3 KVA through 100 KVA

The four transformers now added to the POLE STAR line are fundamentally the same as the original POLE STARS. Cores are wound of cold rolled steel. Core laminations are individually lapped for low exciting current and ease of disassembling and rebuilding the core and coil unit. On 2400 and 4800 volt units straight, side-issuing, high voltage bushings, with insulating caps, replace pockets and pocket bushings. Transformers are of Sealed Tank construction. Synthetic rubber gaskets are used throughout.

In other words: The POLE STAR is a better transformer than the stacked core transformer it replaces. It operates with greater efficiency and at less cost. It is lighter in weight, smaller in dimensions, cheaper to store and easier to install.

Pennsylvania TRANSFORMER COMPANY

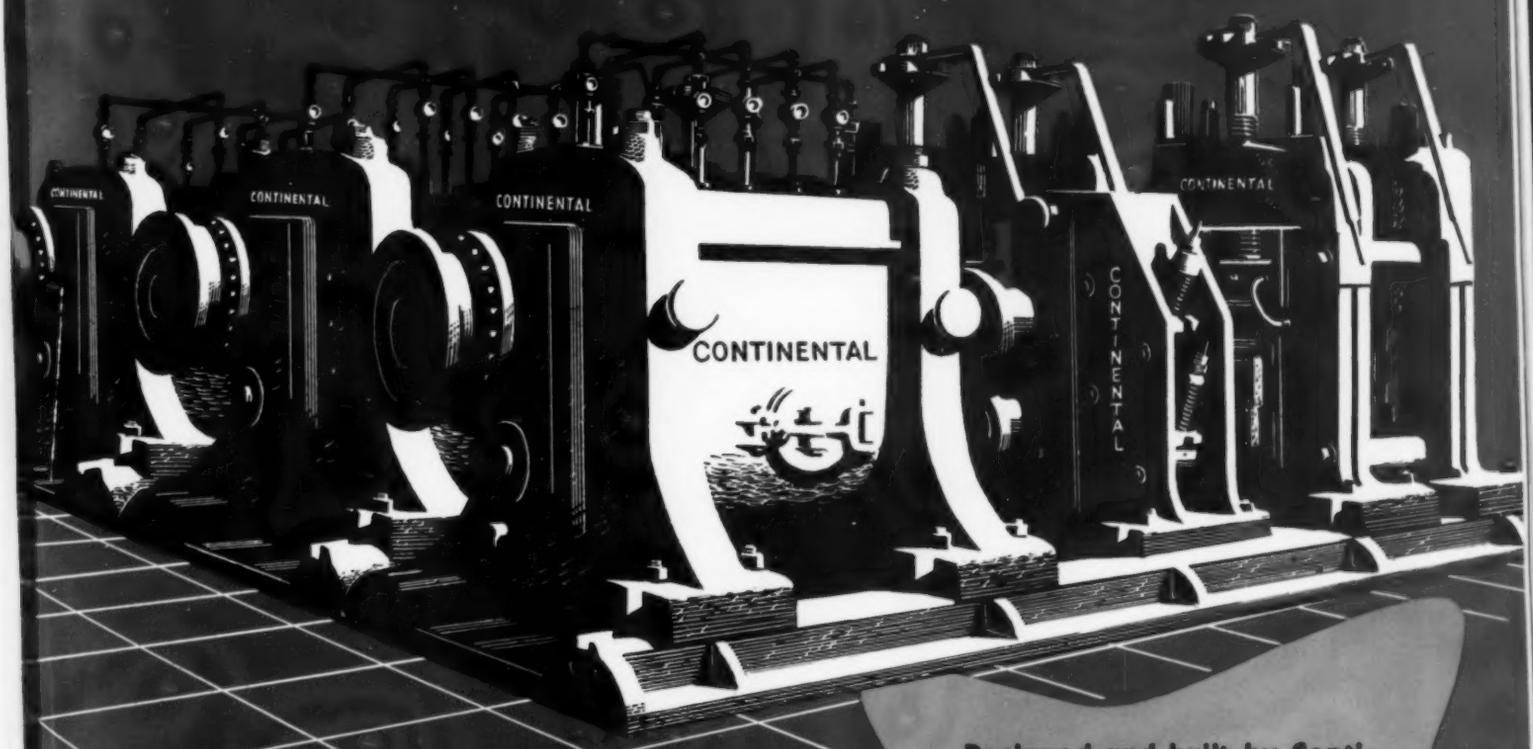
PITTSBURGH 12, PENNSYLVANIA

Write for Catalog No. 1049

P.S. LET THE POLE STAR BE YOUR GUIDE . . . Product Of Long Experience—Safe Thrifty And Reliable

Continental

BILLET and BAR MILLS



Designed and built by Continental with full complement of auxiliary mill equipment.

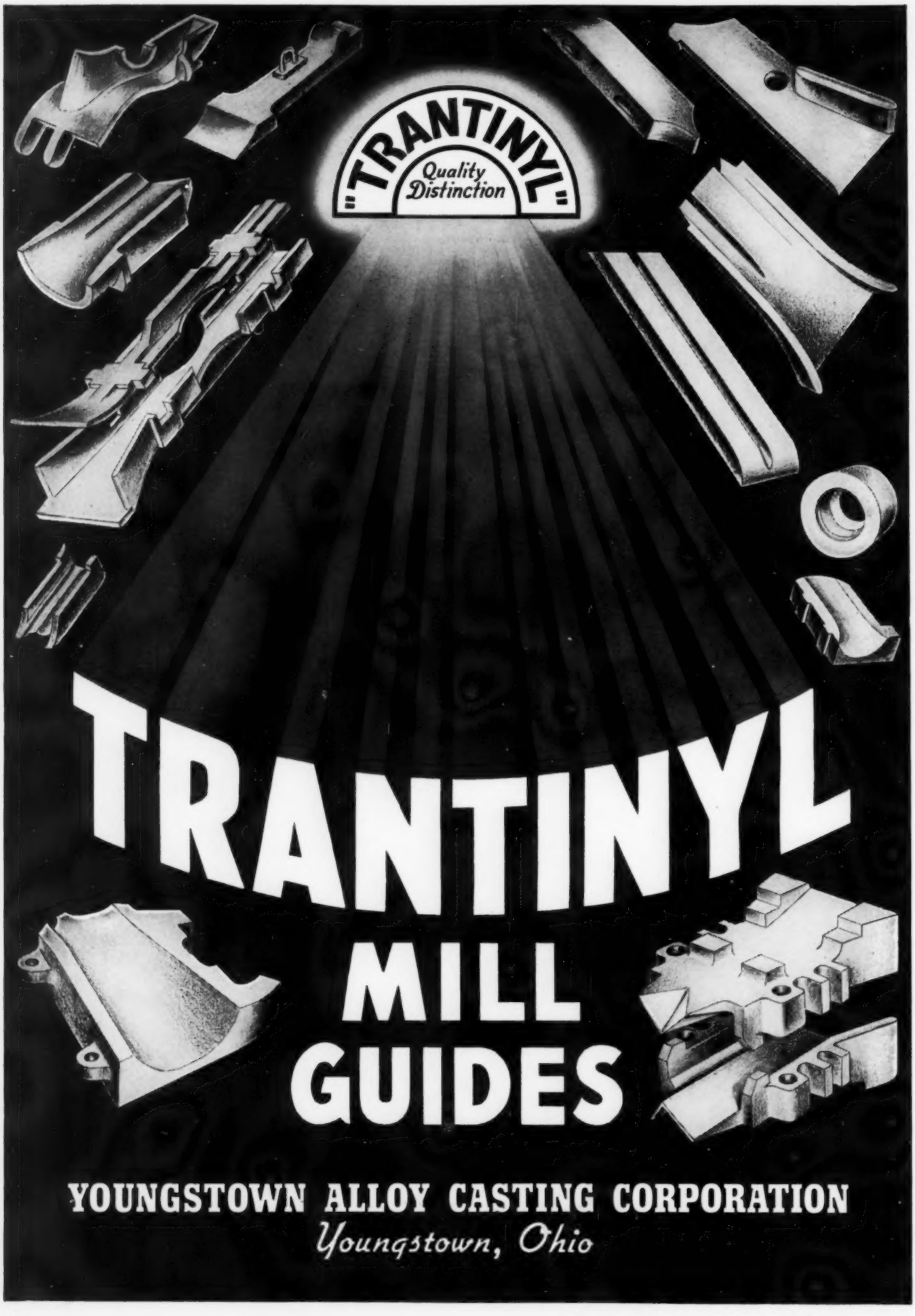
Continental

FOUNDRY & MACHINE CO.

CHICAGO . PITTSBURGH

Plants at: E. Chicago, Ind. Wheeling, W. Va. Pittsburgh, Pa.

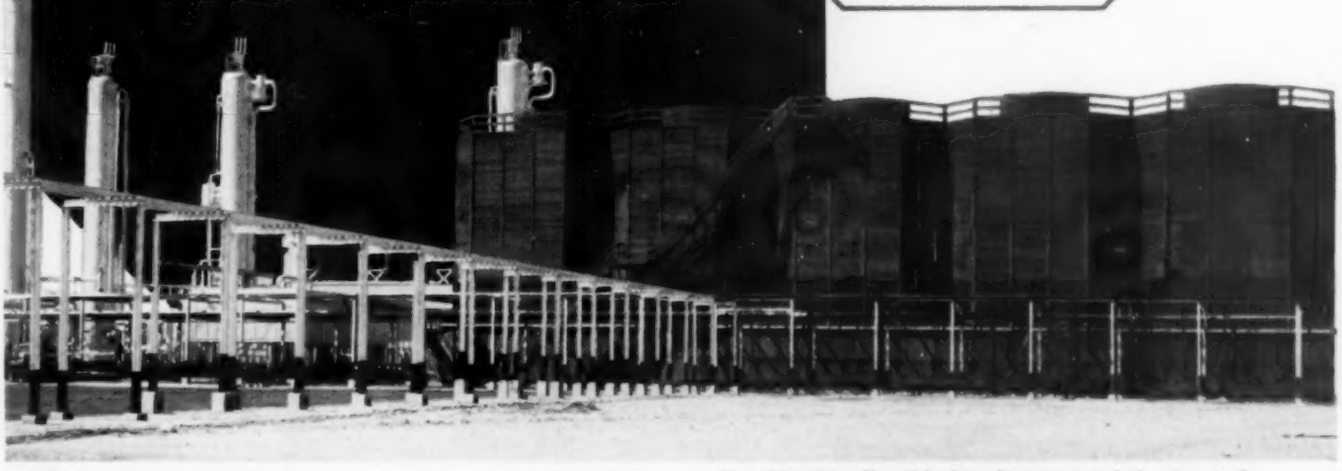
Rolling Mills and Equipment
Iron and Steel Rolls
Carbon and Alloy Steel Castings


TRANTINYL
Quality Distinction
TRANTINYL
MILL
GUIDES
YOUNGSTOWN ALLOY CASTING CORPORATION
Youngstown, Ohio

every FLUOR counterflo cooling tower delivers colder water cheaper

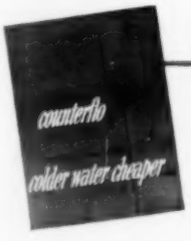
* **colder**
Fluor towers give closest wet-bulb approach

* **cheaper**
Fluor towers cost less per degree of cooling



Five 30 x 30 cell coilshed cooling tower of the Counterflo induced-draft type, built by Fluor for a large gas-gasoline plant. *Guarantee:* 98° to 78° cooling at 73° wet bulb. *Performance:* as guaranteed. Photo by Elwood M. Payne.

Every Fluor *Counterflo* cooling tower cools to the guaranteed temperature! Does this *insured performance* cost you more? No! Fluor towers are prefabricated in standard cell sizes for low erection costs—and engineered to give maximum cooling per fan horsepower.



SAVE YOUR COMPANY MONEY

Before buying a cooling tower, we urge you to look at the engineering *facts* presented in the new booklet "Colder Water Cheaper." Write us for your copy.

BE SURE WITH FLUOR

FLUOR

THE FLUOR CORPORATION, LTD.

Los Angeles 22 • NEW YORK • PITTSBURGH • HOUSTON
BOSTON • TULSA • SAN FRANCISCO

492

Fin-Fan Units

Fluor air-cooled heat exchangers are more economical where make-up water is expensive, where water has bad scaling characteristics, and where the temperature of liquid to be cooled is relatively high. (Manufactured and sold by Fluor and by Griscom-Russell Co.)

Pulsation Dampeners

Fluor pulsation dampeners remove destructive vibrations and instrument irregularities caused by pulsative gas flow.

"BUFFALO" HAS THE MACHINE

To Slash Your Metalworking Costs!

SHEARING HEAVY STOCK FAST
— Eleven Sizes, Up To 10" Rounds!

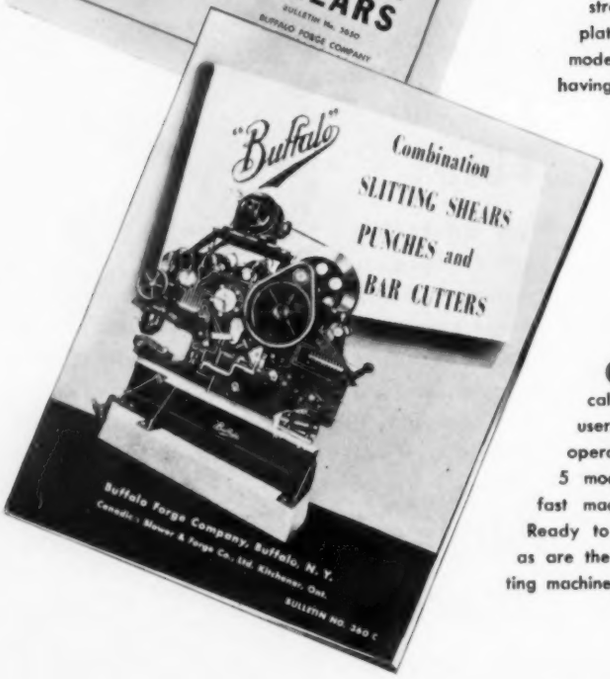
Here's the answer to the problem of getting quick, clean cuts on forging stock! "Buffalo" Billet Shears cut rounds, squares or flats without distortion of "smearing," at high speeds for the heavy pieces they handle. For example, the "Buffalo" No. 17 Billet Shear cuts SIX 10" rounds per minute — SIX 9" squares, or SIX 28 x 4" flats per minute. 10 other sizes for the work you handle. A proven cost-cutter in many shops.

Write for Bulletin 3295-A

PUNCHING, BLANKING, SHEARING
— 250 to 1400 Ton Capacities

Filling the gap between the standard C-type punch or shear and the four-column or straight side press, these heavy-capacity "Buffalo" Mill Type Shears offer many advantages to the busy mill — (1) larger tooling space, open on three sides; (2) great strength, with their stronger electrically-welded steel plate frame; (3) longer power strokes; (4) 12 sizes and models available to suit the operation, each size having two power stroke lengths.

Write For Bulletin 3650



CUTTING, PUNCHING, NOTCHING,
COPING, SHEARING On One Machine!

"Buffalo" Universal Iron Workers have been called "the most useful machine in the shop" by many users because they can perform up to 5 different operations — three operations, simultaneously. 5 models to choose from in this line of powerful, fast machines, capable of 24-hour-a-day service. Ready to pay for itself in a hurry in your shop, as are the other popular bending, drilling and cutting machines in the proven "Buffalo" line.

Write for Bulletin 360C

BUFFALO FORGE COMPANY

173 MORTIMER STREET — BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

DRILLING PUNCHING SHEARING CUTTING BENDING

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

Micarta is really TOUGH

. . . cuts power costs 27%

Many examples are on record where Micarta Roll-Neck Bearings have substantially reduced power costs. This is because the smooth, hard surface of Micarta has a low coefficient of friction . . . saves from 20% to 37% of peak kva demand and kwhr consumption.

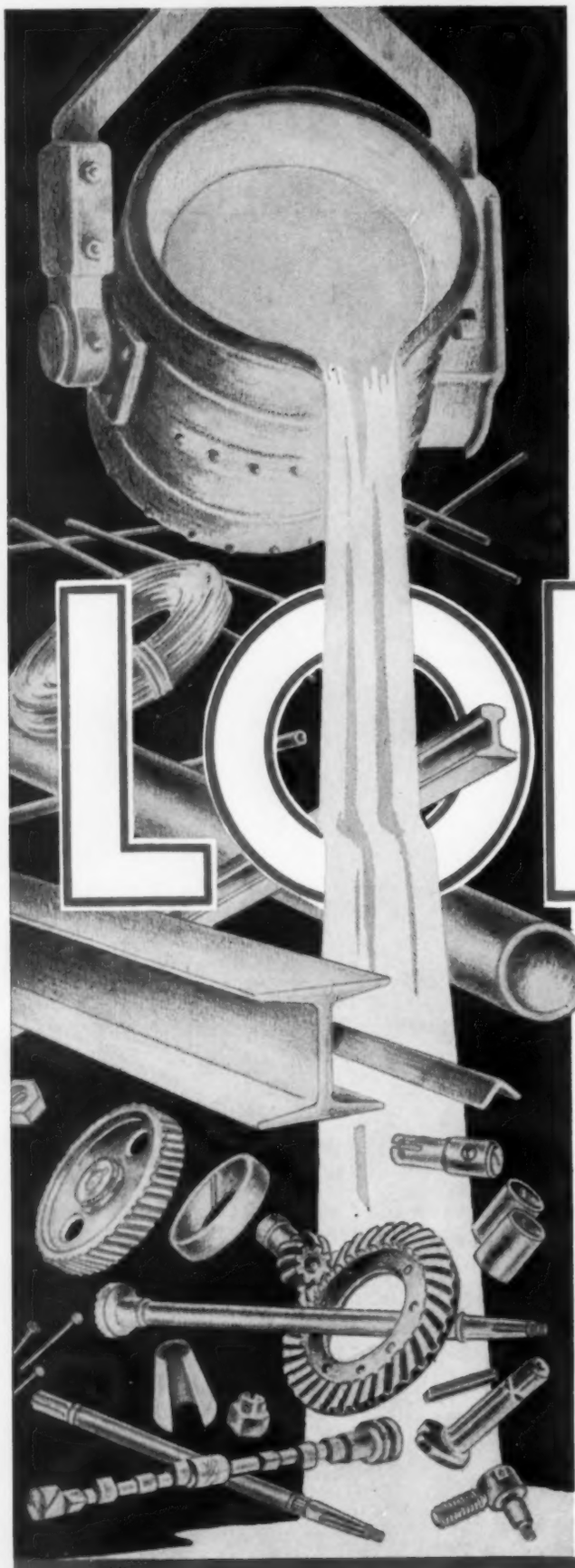
Micarta also eliminates grease costs, because Micarta uses water for lubrication . . . saves both grease and labor. Annual savings up to $5,000 are not unusual.

Water lubrication . . . plus the smooth, self-polishing surface of Micarta . . . prevents roll-neck scoring. Roll-neck life is preserved, too, because Micarta is chemically inert—prevents electrolytic action.

Slow, even wear . . . fewer replacements . . . fewer screw-down adjustments and test bars . . . prevention of "hot necks" and "fire cracks" are more reasons for using Micarta.

Take advantage of this cost-cutting material . . . for roll-neck bearings and other applications, too. Ask your near-by Westinghouse office for Book B-3776, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-06419

Westinghouse Micarta



LOFTUS

Loftus Designs and Engineers Complete Plants and Individual Furnaces for the ferrous or non-ferrous industries - From the Open Hearth to the Heating Furnaces for the final rolling - Then from the metal stock to the Heat Treating Line. The Loftus organization serves the metallurgical field from melting and refining to the finished heat-treated product.

610 SMITHFIELD ST. **LOFTUS ENGINEERING** *corporation* PITTSBURGH, PA.

Designers and Builders — Engineers, Consultants, Contractors

Midwestern Steel Plant Cuts Lath Handling Man-Hours 85%

. . . Loads 46% more Lath with Automatic TRANSPORTERS & TRANSTACKERS

Transporter Brings Lath to Boxcar
Fifty bundles of lath, strapped to a skid, are brought to the boxcar for shipment. Load is moved on battery-operated platform Transporter, famed hand truck made by Automatic. Before, lath was carried manually in loads of ten bundles at a time.

Hand Trucks Team Up to Save Time and Lower Costs
Load of lath brought to boxcar by Transporter is taken over at that point by Transtacker, battery-operated stacking unit. Transtacker will tier loads of 50 bundles two high until both ends of the car are filled.

Car Loaded Quickly by Transtacker
Combined efforts of Transporter and Transtacker effect considerable reduction in materials handling time. Mechanized operation permits handling 1300 bundles of lath in six man-hours. Without machines, lath was loaded at the rate of 834 bundles in 40 man-hours. 85% reduction in handling time, 46% increase in volume loaded.

● *An 85% slash in man-hours despite a 46% increase in volume handled* was accomplished by mechanizing the lath handling methods in a large midwestern steel company.

Before the introduction of Automatic Transportation Company material handling equipment, the bundles of lath were transported around the plant manually. This involved moving them from the point where they were tied, to the warehouse, and eventually to the railroad siding where they were loaded by hand into the boxcar.

Using this technique throughout, the operation was slow and costly. In the boxcar loading phase, for example, a full eight-hour day was consumed while five men loaded 834 bundles of lath into the carrier.

When Automatic Fork Trucks, Transporters and Transtackers were put to work, 1300 bundles were loaded by the Transporter and Transtacker team . . . instead of five men working eight hours a day, or 40 man-hours—two men work three hours, or six man-hours.

The pictures on the left show and tell how this loading operation was handled. There is an Automatic Electric Truck for any and every steel operation. Send coupon for complete catalog of Electric Trucks suitable in your industry.

Automatic
ELECTRIC TRUCKS
Lighten LIFE'S LOADS

Trade Automatic Mark

47 W. 87th St., Dept. P-9, Chicago 20, Ill.

Please send me free Catalog describing Automatic Electric Trucks for handling steel and allied products.

Company Name .....

By ..... *Position* .....

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TREADWELL

STEEL PLATE CONSTRUCTION

DISTILLATION CYLINDERS
9'-0" DIAMETER • 126'-0" LONG • 131,000 LBS. EACH.
EACH CYLINDER SHIPPED IN ONE PIECE

HOMOGENEOUS LEAD LINED EQUIPMENT
OPEN HEARTH AND HOT METAL LADLES
STEEL PLANT TRANSFER CARS
HYDRAULIC GATES
PRESSURE VESSELS
PENSTOCKS
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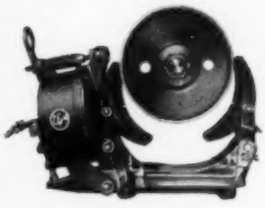
1217 FARMERS BANK BLDG.
PITTSBURGH 22, PA.
ATlantic 1-8983

Complete Control for Cranes

SHORT-THROW narrow width Cam Master Switches are easy on the operator.



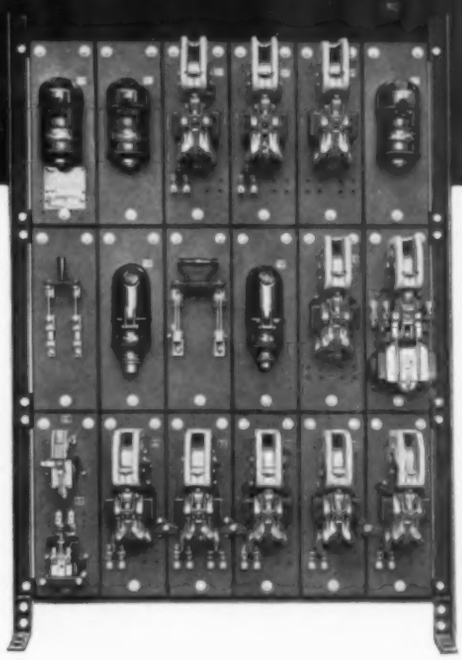
LONG-LIFE Brakes give high speed performance—with low up-keep.

TIME-CURRENT Relay matches acceleration to the d-c load.

YOUNGSTOWN Safety Limit Stop — a positive check against human error.

Three Main Advantages Offered in...

SIMPLIFIED DYNAMIC LOWERING CONTROL FOR D-c HOISTS



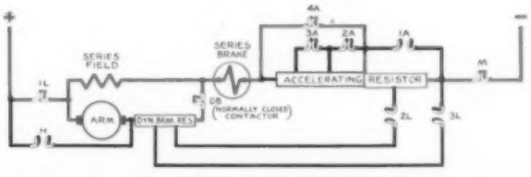
1. Easily understood circuit—clean-cut controller.
2. Heavy Loads can not over-speed should any contactor or relay fail to operate.
3. Fast Brake Release permits accurate inching.

The EC&M Wright Circuit — highly regarded for its trouble-free, high out-put performance.

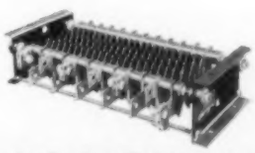
More trips per minute because it gets "*down* to work quickly" is an important characteristic of the EC&M Wright Circuit Hoist Controller. It differs from previous hoist controllers in that only *full load current* is drawn from the line on first point lowering, and that *all* of this current passes through the brake coil for fast brake release. High speed lowering of light loads and the empty hook is also a standard feature of this EC&M Crane Controller.

Operators, too, appreciate the advantage of *complete control* of the load in lowering. Each step is under direct control of the master switch. And this circuit is safe at all times. For D-c Hoists, specify the EC&M Wright circuit.

First point lowering uses all the line current for quick brake release.



TAB-WELD Resistors—no burning where burning would cause high up-keep.



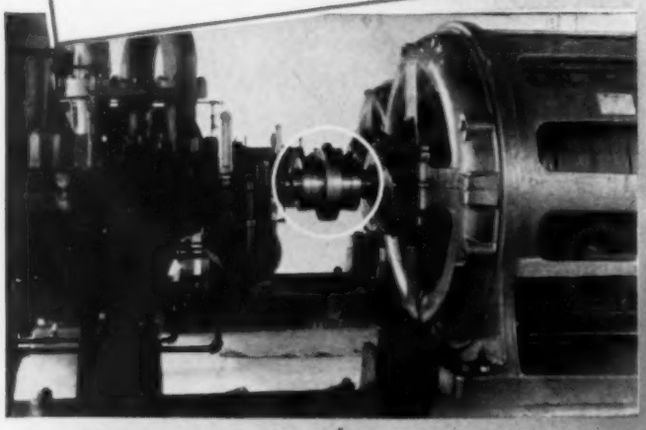
CRANE DISCONNECT SWITCH Manual-magnetic for ease of operation.

THE ELECTRIC CONTROLLER & MFG. CO.

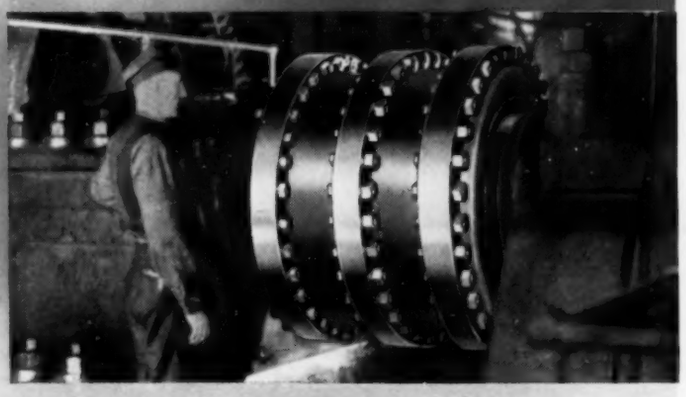
2698 EAST 79TH STREET ★ CLEVELAND 4, OHIO

How Fast's Exclusive Metal to Metal Seal *Boosts* Your Plant's Production

Correctly engineered oil-protecting "rocking bearing" allows freedom of movement to compensate for misalignment because spherical base has same axis as hub spline faces!



OIL REFINERIES insist on Fast's Couplings to *keep* their vital machinery *running*, because they know Fast's virtually *eliminate* all shutdowns due to coupling failure! This Coupling has been in service since 1931.



STEEL MILLS specify Fast's Couplings for equipment of every shaft size to avoid costly production shutdowns caused by failure of ordinary couplings! This Coupling has been in use since 1923!

YOUR production figures *go up* and *stay up* when your vital equipment is protected with Fast's Couplings, because Fast's virtually eliminate all shutdowns due to coupling failure. Fast's use no perishable parts or packing rings . . . they are the *original* gear-type coupling that *really* guards load-carrying oil from moisture, abrasive dust and grit! Fast's have *exclusive* "rocking bearing" principle that gives *sure* metal-to-metal seal.

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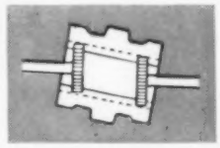
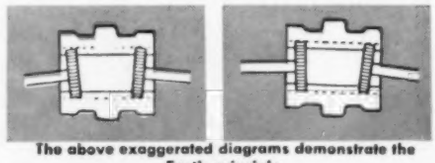
FAST'S COUPLINGS COMPENSATE FOR ALL MISALIGNMENT

The floating sleeve takes a neutral position. All forms of misalignment are compensated for between the lubricated faces of the splines, equally divided between the driving and driven members. The entire assembly revolves as one unit.





The above exaggerated diagrams demonstrate the Fast's principle.

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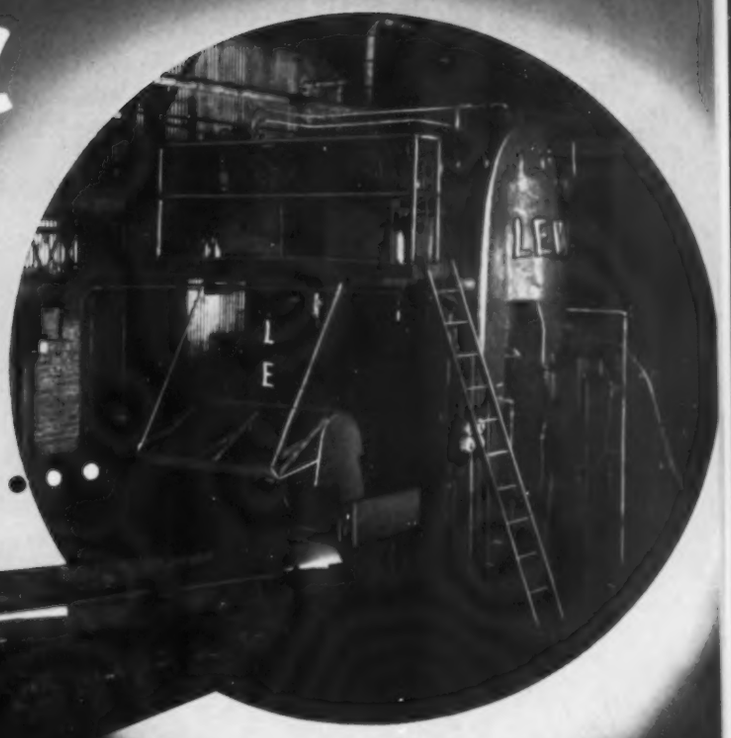

Desire for improvement of finished product and reductions in costs inspired the installation of this LEWIS 3-High Roughing Mill—for finishing light plate and breakdowns for strip—at the Carnegie, Pa., plant of the Superior Steel Corporation.

...by

LEWIS

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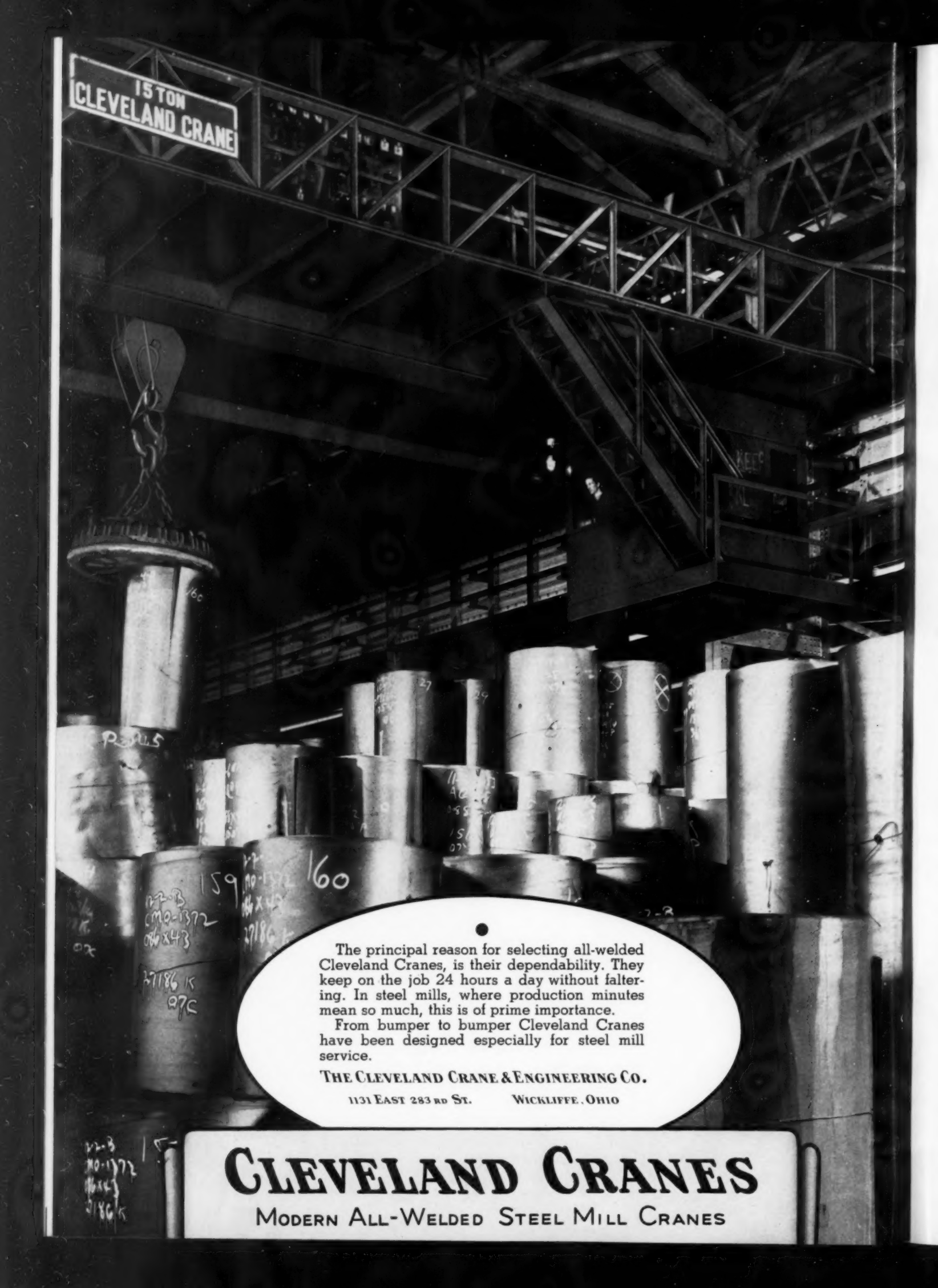

The principal reason for selecting all-welded Cleveland Cranes, is their dependability. They keep on the job 24 hours a day without faltering. In steel mills, where production minutes mean so much, this is of prime importance.

From bumper to bumper Cleveland Cranes have been designed especially for steel mill service.

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CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

Crops *and* Shorts

THREE years of bookkeeping in black ink are apparently all that Washington could stand. As of some weeks ago, government spending is back in the red, so popular over the past two decades. But still the pressure is on for record benefits for the "peepul," including all backward sections of the world — all at a cost that is beyond our comprehension, and all entailing further deficit spending.

Our government now takes 26.8 per cent of our total national income, more than twice the proportion taken in 1929. In Britain, taxes absorb about 40 per cent of the national income, but just give us time — we'll catch up. That is, we will unless we shed our complacency and call a halt on the powerful spending group, who, perhaps unwittingly, are doing more to undermine this nation than are the communists.

It is high time that we all go to work to stop reckless government spending. Let's demand action on the recommendations of the Hoover commission for elimination of waste. Let's explode the idea that prosperity comes from running into debt, and that all these fine benefits dangled before us are ours for free, through the beneficence of a paternal government. Let's go back to sanity — and solvency.

▲

AND while we're about it, let's declare war on the monopolistic practices of labor unions. The miner's three-day week is a fine case in point. If we may interject a personal experience, we'd like to tell about the men who were laboring on the lawn and shrubbery of a new house in our neighborhood. They were coal miners, whose three-day work week wasn't supporting their families. These men want to work a longer week, but are prevented by the dictum of the most complete monopoly in the country, so they are eking out an existence by getting a second job.

On the other hand, John L. Lewis' three-day-week edict has caused the idling of much mining machinery, in which mine owners have invested large sums of money. This is the equipment that has made the miners' jobs easier and has raised their productivity to a level that enables them to earn high wages. Worked three days a week, the investment cannot be justified. The machinery cannot support itself. But can the owners bring in other men so that their investment can eke out an existence? They would be damned as oppressors, the substitute workers would be "scabs," and violence would result. Free enterprise — it's wonderful!

▲

NOW that the labor day flood of oratory has brought an end to the vacation season, we're glad to learn from the fall fashion notes that they're wearing the same thing in brassieres this season.

▲

INDUSTRY is slowly realizing that physically handicapped individuals, when placed with due regard for their abilities and their disabilities, produce results that compare favorably with records of able-bodied workers. Employment of handicapped, where they will fit in, is a fine thing for the individuals themselves, and for the company as well, for the handicapped often turn out to be more interested and more reliable than their more fortunate fellow-workers.

▲

WOMEN are entering professional careers in ever-increasing numbers. There are now over 1000 who have taken up law. There are probably 50,000,000 who are laying it down.

▲

TWO books recently published give some interesting highlights on the management philosophy of two prominent industrial corporations. "Bottom-Up Management," by William B. Given, Jr., president of American Brake Shoe Company, sets forth a policy of giving supervisory people greater freedom, leaving to foremen, superintendents and intermediate executives the basic job of devising work methods to execute top management policy. In explaining the workings of this system in his own company, Mr. Given says: "The responsibility of a business is to give every good man maximum opportunity."

A similar thought is expressed in "Precision, People and Progress," published by Leeds & Northrup Company, whose founder, Morris E. Leeds, saw industry as "a democratic institution based, not on equality of power or equality of reward, but on equality of opportunity." Mr. Leeds once stated: "A business organization should be a unified group of people banded together to earn a living for its members, seeking to do justice among all of them and to the rest of the world."

▲

A POSTER in the office of American Brake Shoe Company offers this pertinent thought:

Jobs depend on orders.
Orders **depend** on prices.
Prices depend **on** costs.
Costs depend on **you.**

▲

THERE are two kinds of men who never amount to much: those who cannot do what they are told, and those who can do nothing else.

▲

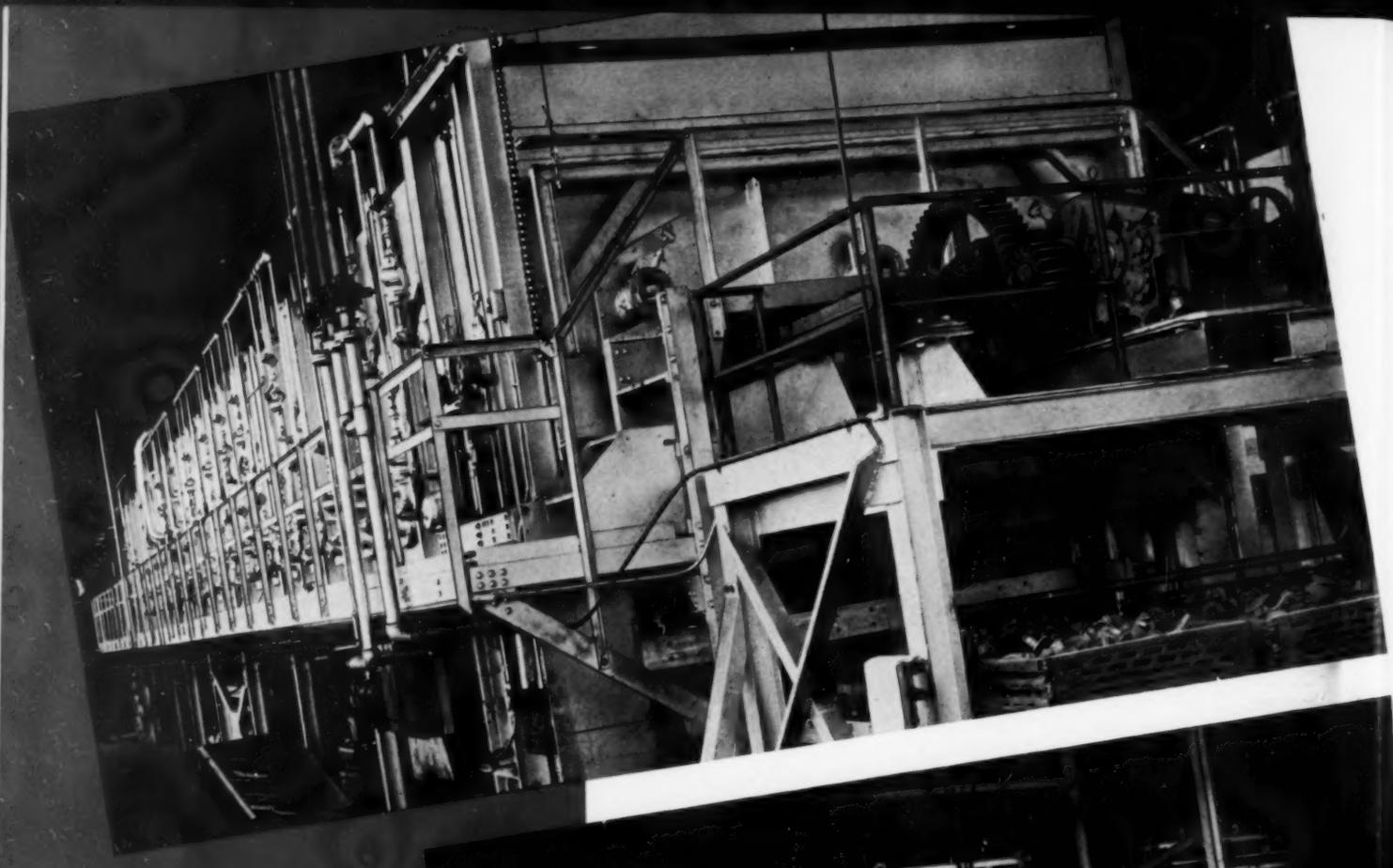
ACCOMPANYING the peace-time record steel production of 1948 was an all-time low in accident frequency. The figure of 5.86 accidents per million manhours worked put the steel industry fourth among 40 major industries, and was 49 per cent lower than the average for all industries.

▲

SOME people used to judge a woman's character by her clothes, but lately the evidence has become insufficient.

▲

PEOPLE don't really become maniacs when they get behind the wheel of an automobile. They only act like it.



- Continuous atmospheric control
- Precision heat regulation
- Low gas consumption

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Swindell Bottom Entry Malleable Furnaces, with specialized design and construction features, provide outstandingly efficient performance in malleable castings production. *May we have your inquiry?*

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A CLUE TO LIFETIME CABLE VALUE

Look for this ridge and you find a reason . . .

It's the mark of an Okonite cable, proof that highest quality insulation has been applied to the conductor by Okonite's strip process. Still prominent after removal of the continuous metal vulcanizing mold, this ridge symbolizes many extra engineering features built-in to make sure Okonite outperforms ordinary cables . . . offers true economy in these days of high installation costs.

HERE, FOR EXAMPLE, IS A CABLE THAT'S PROTECTED 4 WAYS

It is a cable with a long and extensive service record. It is an Okolite-Okoprene cable with extra protection from conductor coating to sheath. It passes, in addition to a-c tests, high voltage d-c tests more severe than those required by any other manufacturer.

Into four different parts of this cable, extra service life is built . . . *at the conductor* (1) by a coating of Okoloy, a special corrosion-resistant lead alloy that outlasts tinning 2 to 1 . . . *about the conductor* (2) where an application of Semicon tape – on all Okolite-Okoprene cables operating at over 2000 volts – eliminates internal corona cutting and increases dielectric strength.

True cable value is added *by the insulation* (3) which is moisture-resisting, high-voltage Okolite made with Up-River Fine Para Rubber, the best grade of natural rubber. Okolite, an oil base insulation, has been proved in over 20 years of service, and is approved by Underwriters' Laboratories, Inc. as Type RWSN. *The outer sheath* (4) is Okoprene, the pioneer neoprene cable covering developed in the Okonite laboratories. Its life-extending durability and stable characteristics have been demonstrated on millions of feet of cable installed during the last 14 years.

Okolite-Okoprene cables possess many advantages from the standpoints of installation, electrical operation and design. These, along with dimensions and other data, are combined in an illustrated Bulletin IS-1037. For a copy, address The Okonite Company, Passaic, New Jersey.

THE BEST CABLE IS YOUR BEST POLICY

OKONITE SINCE 1878 ***insulated wires and cables***

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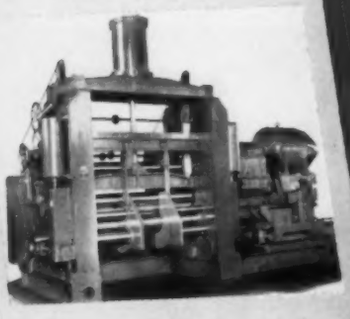
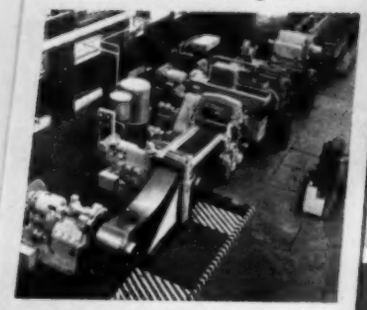


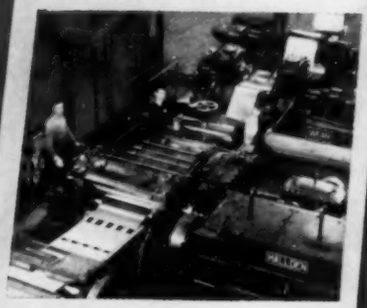
Continuous Electrolytic Cleaning Line

Continuous Hot-Dip Galvanizing Line

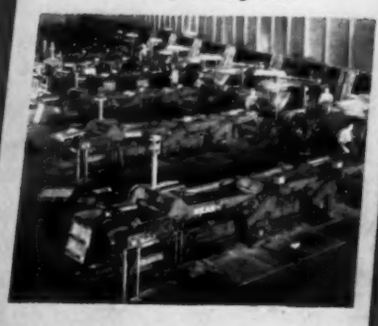
Continuous Coating Line



Tin Plate Shearing Line



Hot-Dip Tinning Units



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Iron and Steel ENGINEER

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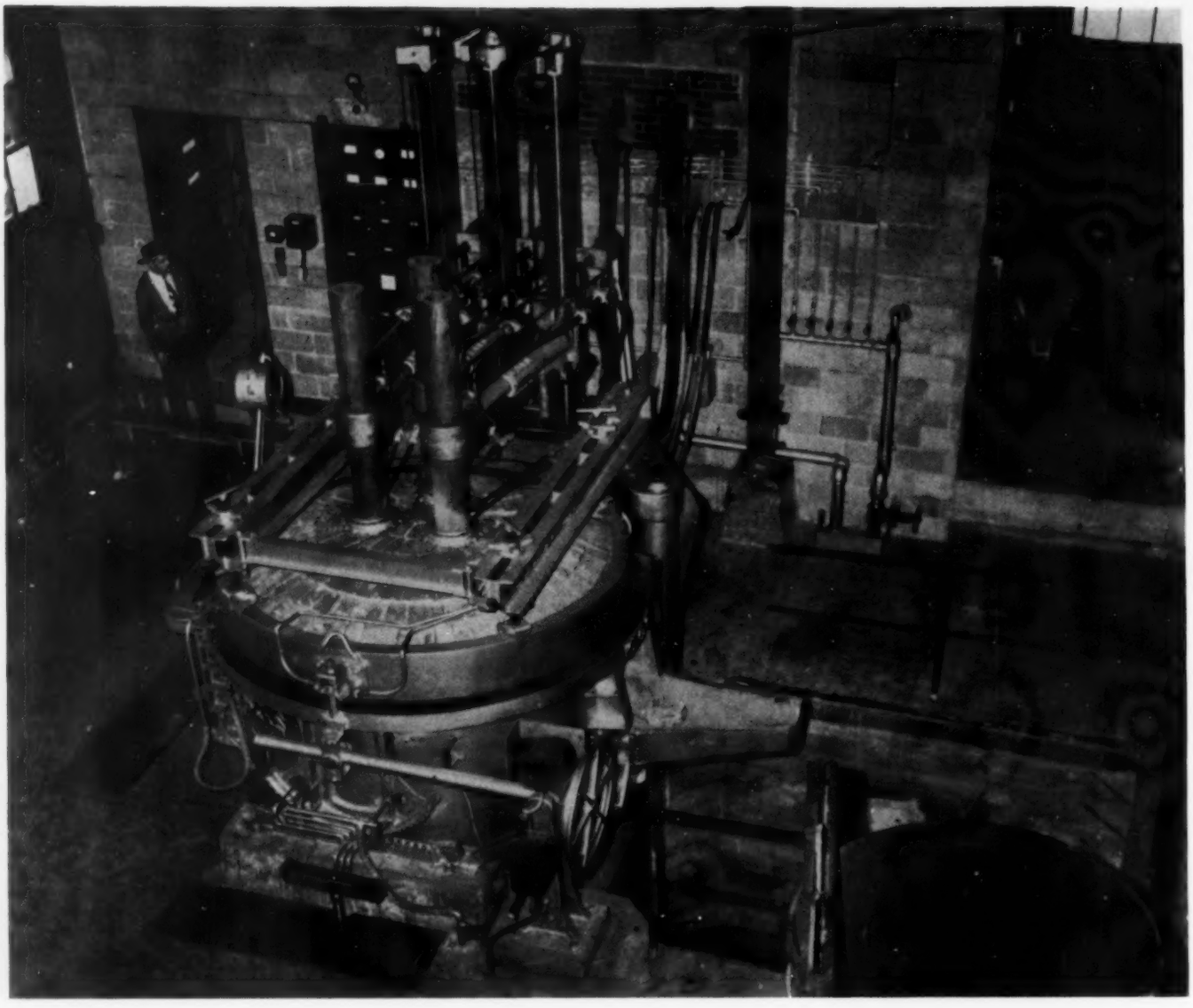

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MODERN SEALING DEVICES

for the Steel Industry

By R. A. KRAUS
General Millwright Foreman
Republic Steel Corp.
Chicago, Ill.

. . . . not to be overlooked in the design of a piece of equipment are the seals, upon whose successful operation, bearing performance is dependent . . . .

▲ WITH the continued progress in design of higher capacity plain and antifriction bearings, as well as the steadily mounting working pressure, and scope of application of hydraulic devices in heavy industry, we find that all too frequently the necessary sealing devices incorporated in the mechanism will frequently become the mechanism's weakest link. Bearings which were designed to operate efficiently for long periods will often fail prematurely due to the inability of a sealing device to exclude outside contamination from the lubricating medium. Similarly, other seal failures may so reduce the amount of lubricant available to bearings, gears and other moving parts, that premature failure is impossible to prevent without the use of undue labor to increase the rate of lubricant application. In many cases premature failures of this type mean the unscheduled shutdown of vital production equipment with a resulting loss of unrecoverable production.

With this thought in mind, it behooves management to insist that the engineering and maintenance groups continually keep abreast of seal device progress, so that the best type seal will be used for each application. As improvements in the methods of sealing out solid and fluid contaminants, or the more efficient retention of lubricants or other fluids are developed and proven, these groups should avail themselves of the new development as the opportunity permits, in order to promote fewer production delays as well as a generally decreased maintenance cost. In a corresponding manner, the maintenance force should be thoroughly familiar with all of the factors influencing the useful life of sealing devices, so that upon routine replacement, the new sealing member is not installed in such a manner, or under such circumstances, that an early failure is predestined.

In addition to the critical task of first selecting the proper design of seal, and the types of materials from which it is to be manufactured, the maintenance force must also consider in detail such factors as surface finish of the mating member, method of seal assembly, interference fit of the seal in the housing, provision for pressure relief where necessary, amount of shaft runout permissible, optimum shaft hardness, provision for seal lubrication, as well as a number of other factors in order to obtain the desired life cycle of the sealing device. These factors must each be considered in order to obtain the full value of the time spent and the materials used in the assembly of any seal device.

That there has been progress in sealing devices is evidenced by the records of the United States Patent Office, where well over 2,000 individual patents have been granted covering seals. To investigate each patent would be a considerable task, although one which would be undoubtedly valuable. For our purposes, a resume of some of the more typical types of seal devices available for generalized work will be adequate. We shall find that no type is a cure-all, and that each has its limiting factors such as speed, temperature, pressure, installation difficulties, working medium resistance, or cost.

For an efficient investigation into sealing devices in general, we must first reduce the overall problem to smaller components in order to properly evaluate and compare the various types of seals available for each subdivision. While a number of methods of division are available, the method utilizing the type of motion en-

Presented before AISE Annual Convention, Cleveland, Ohio, September 30, 1948

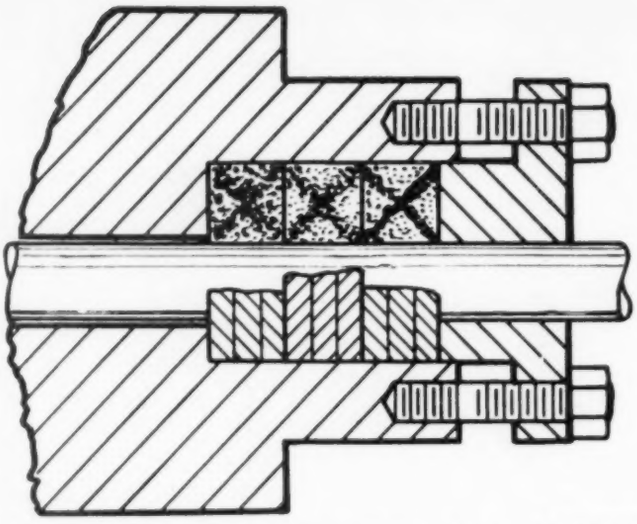
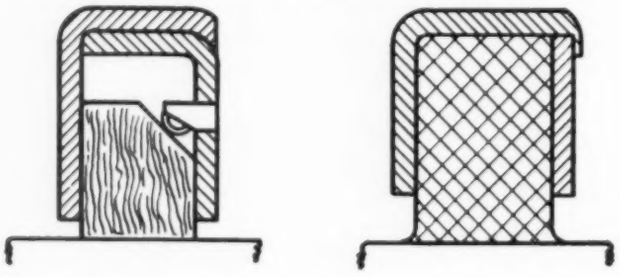


Figure 1 — The packing gland seal is probably the oldest and most familiar type.

Figure 2 — On the left is shown a cork type seal and on the right is shown a felt type seal.



countered at the sealing interface will suffice. These motions are:

1. Rotating shafts.
2. Oscillating shafts.
3. Reciprocating shafts and plungers.

Those seals employed in rotating shaft installations represent the largest single group or subdivision of seal types, and it is of this type with which we are to be concerned in this paper. Oscillating shaft problems can in most cases be solved by the same methods as rotating shafts, but there are solutions to oscillating shaft problems which will not apply to rotating motions. In the category of rotating shafts, we shall include pumps handling many kinds of fluids, seals for gear reduction cases, seals for ball or roller bearing installations on such equipment as table rolls and drives, machine tools, electric motors, automotive equipment, cranes, and many other similar items; seals for the more modern design of plain sleeve bearings for all types of equipment, and of course large diameter seals such as are used in strip mill operations, centrifugal casting machines, etc.

A review of the foregoing seal installations will show that seals are used for either of two primary purposes. First, they are frequently called upon to retain lubricants under varying conditions of pressure, or in certain specialized cases, such as pressure and transfer pumps and similar equipment, they must retain other fluids under pressure, which may not have lubricating properties. Under the latter mentioned condition, a lubricating medium must generally be provided for the seal. Thus, it is evident that if they are to be successful in these applications, they must have a definite measure of pressure tightness. Secondly, their function may be to exclude from a given device or mechanism, such things as dirt, water, noxious fumes, or other nonpalpable matter. Where both functions of pressure retention and contaminant exclusion are found necessary in one installation, combinations of seal types can be used, or special types of unit seals may be employed.

Seals for rotating shafts take several distinct forms and the range of usefulness of each type should be recognized. The oldest form, and one with which everyone is familiar is indicated on Figure 1 where we see the packing gland type of sealing device for rotating shafts.

This type of seal, with various modifications, was formerly used extensively for pressure retention on a great variety of equipment, but now is being replaced by more modern seal designs in many instances. The type of material used as the packing varies widely with the type of service and with the operating conditions.

Basic packing materials include asbestos, plastics, flax, jute, cotton, rayon, rubber and several metallic materials. Packings are composed of one or more of these materials in a wide variety of weaves and shapes and are impregnated with various lubricants and fillers such as mineral and polar type oils and fats, graphite, mica or glycerine to reduce the frictional characteristics of the material.

For service against gas and steam pressures, metallic and semi-metallic packings and asbestos materials are usually recommended, while for water service, flax, jute, cotton and rayon materials may be included.

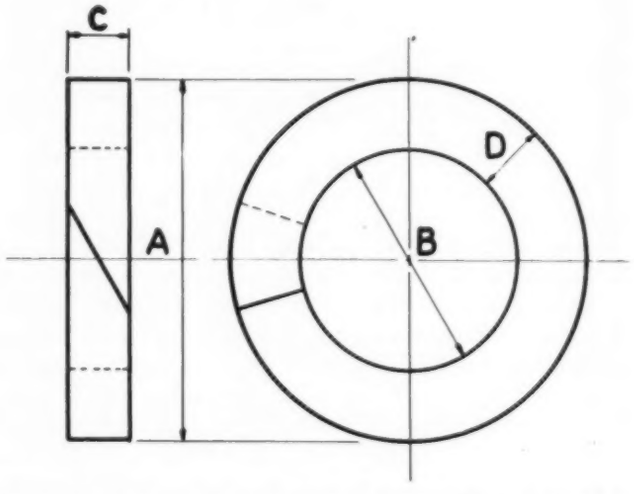
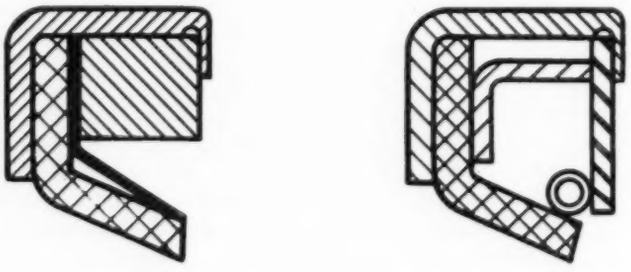


Figure 3 — Proper proportions are essential for good seal operations.

Figure 4 — On the left is shown a lip finger seal and on the right is shown a lip garter seal.



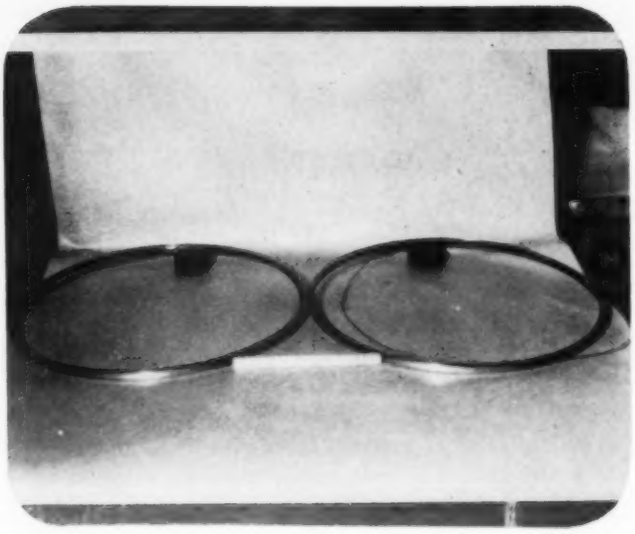


Figure 5 — Backup roll bearings require some of the largest seals which are made.

With gasoline and oil service, metallic packings or asbestos compounds are useful. Acid and caustic service will usually require special blue asbestos packings or possibly semi-metallics.

Seals of this type are being replaced in many instances due to the fact that they are highly susceptible to shaft eccentricity and are poorly adapted to high speed service. Initial shaft surface finish is important to long packing life and unfortunately is usually damaged rapidly by use of this type seal when operating under dirty conditions or with faulty adjustment, with the result that future repackings are invariably short lived. The damage done by one poor packing job may last long after the man responsible is gone, with actual shaft replacement necessary in many cases.

The friction loss encountered with this type is relatively high, and heating and damage frequently will result unless operating and installation conditions are ideal. The packing material used can be varied to suit temperature conditions as well as the fluid to be retained, and so seal designs of this type are most useful for unusual fluids or conditions not applicable to other designs.

Figure 2 indicates fabricated unit seal types using cork, felt, asbestos or a similar material as the sealing element. Seals of this type are at times used for retaining lubricants, but even more frequently are used in combination with other types of seals as the dust excluding seal. These seals are generally inexpensive, are relatively easy to install, and are satisfactory for many applications. In many machine designs, we find that relatively little consideration has been given to sealing problems, and in these cases the maintenance force can frequently help itself by the installation of home fabricated or purchased unit type split felt seals on older equipment where no provision was originally made for dust exclusion or lubricant retention. In all cases, the bearing life will be extended with a decreased lubricant consumption realized, and frequently with a decreased housekeeping expense.

Felt seals are most useful on shafts having peripheral speeds under 2000 fpm with lubrication present and with good surface finish and hardness of shaft. However, felt has the ability of retaining its own lubrication for considerable periods, and thus has an advantage over many other types when used as a dust or water seal. While 2000 fpm is considered top conservative design, there are applications operating at speeds as high as 4000 fpm. Felt has sufficient resiliency to permit some shaft deflection or runout and frequently will operate satisfactorily against poorer surface finishes if other conditions are favorable. Shaft scoring is encountered in some instances when operating dry in dusty conditions, due to the felt loading up with solid contaminants and acting as a lap. However, grease impregnated or oiled felts are considerably more resistant to this loading tendency, and consequently lubrication is desirable.

When ordering or installing felt seals, the purchasing and maintenance departments should exercise diligent care in the proper selection and purchase of these materials, insisting on pressed felts of 100 per cent wool. Woven felts or those felts containing vegetable fibre fillers usually are not as satisfactory in sealing or as long lived as the better quality felts.

Using the common SAE designations for types of felt, which grade felts from SAE F1 or hard felt through SAE F11 or softer felt, Table I, indicates typical types for specific cases.

TABLE I — FELT SEALS

	SAE Grades
Dust exclusion	
Mild service — To 650 fpm	F7, F13, F15
Severe service — 650 to 1200 fpm	F5, F6
Lubricant retention	
Mild service — To 1200 fpm	F3, F5, F6
Mild service — Over 1200 fpm	F10, F11
Severe service — To 1200 fpm	F10, F11
Severe service — 1200 to 1800 fpm	F5
Severe service — Over 1800 fpm	F10

If possible when cutting felt seals, certain shape relationships should be followed if maximum performance is desired. For a well designed felt seal, the differ-

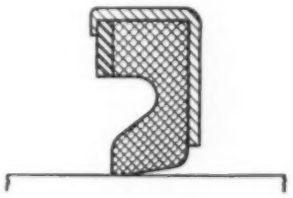
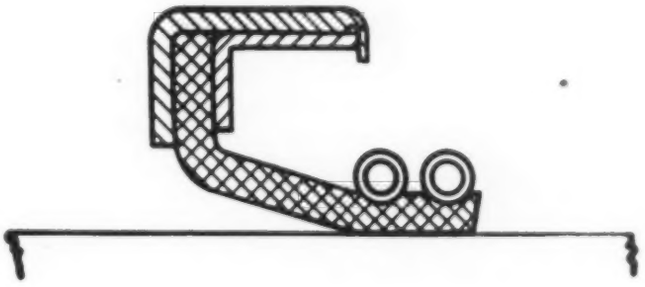


Figure 6 — The springless type seal can give good operation where pressure variation is small.

Figure 7 — The long lip type seal often gives unusually good results where the required clearances are available.



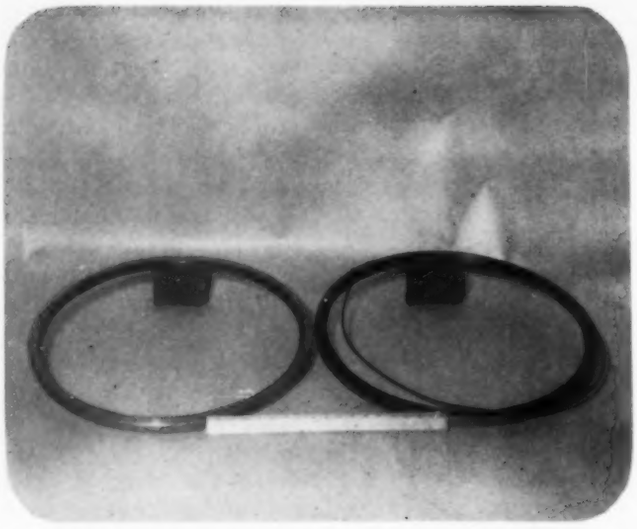


Figure 8 — A seal for a 20 in. work roll bearing is given in this figure.

ence between the inside radius and the outside radius (dimension "D" on Figure 3) should be at least 25 to 50 per cent greater than the felt washer thickness (dimension "C"). Thicknesses less than $\frac{3}{16}$ to $\frac{1}{8}$ in. are not usually satisfactory since too many of the component hairs are cut too short, thereby adversely affecting resiliency and wear resistance. If split washers are necessary, they are best prepared using a bias cut as indicated in the figure.

For most efficient sealing, the inside diameter of the felt ring should be cut with a certain amount of interference with the shaft or in other words, the felt ring is given negative clearance. The exact amount of this interference varies primarily with the speed. Assuming normal operating conditions, the felt washer should be 0.020 to 0.030 in. smaller than the shaft per inch of shaft diameter for speeds under 900 fpm. This is equivalent to a 2 to 3 per cent interference fit. For speeds above this range, but less than 2000 fpm a $\frac{1}{2}$ to 1 per cent interference fit, or in terms of actual dimensions, 0.005 to 0.010 in. interference per inch of shaft diameter is generally recommended. Above 2000 fpm, the inside diameter of the felt washer should be equal to the shaft diameter or excessive heating may occur.

Special impregnated felts are generally available for higher heat resistance, waterproofing, etc., and in addition, laminated felt and rubber seals are available for jobs where porosity is not desirable.

Figure 4 indicates the common fabricated unit lip type seal. This seal at present is the most commonly used design due to its adaptability and good service characteristics. Basically the design includes the actual seal element, a seal interface loading device, such as a finger spring or garter spring or a resilient filler material, and a case or housing to contain the various parts and to permit a convenient method of mounting.

This type of seal is useful as either a mild pressure retaining device up to pressures of approximately 10 to 20 psi, or as an efficient contaminant exclusion device. The characteristics of this seal permit its use at speeds up to approximately 1000 fpm with most standard units, and to speeds between 2000 and 3000 fpm with certain modifications in design to give less frictional heat. These speeds will handle most mill requirements since 2000 fpm represents a 1 in. shaft turning at 8000 rpm, or a 4 in. shaft turning at 2000 rpm. These higher speed seals are not effective pressure sealing devices, due to the lower lip contact pressure necessary for their operation.

Seals using this general type of construction can be made in a wide range of sizes. Seals for $\frac{1}{4}$ in. shafts are stock items with several companies while special order seals can be made over 50 in. in diameter for strip mill bearings, etc. Figure 5 shows the front and rear view of a 40 in. seal for a back-up roll bearing. The garter spring is clearly shown.

Seals of this general type (Figure 6) can be designed to hold higher pressures providing the pressure does not fluctuate widely, and providing the speed is not high. In these instances the pressure is used as the

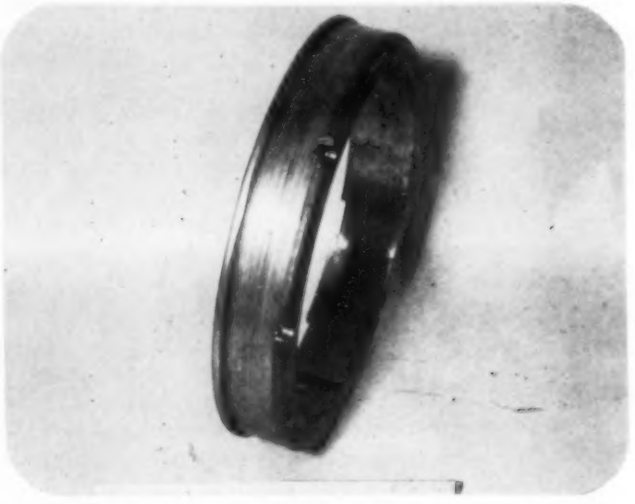


Figure 9 — Shown is the spacer for the seals of Figure 8.

sealing force and mechanical springs can usually be eliminated. Instances of successful operation at 100 psi pressure are on record. However, it should be remembered that higher pressure units are not generally advisable if speed is also a factor. Other types of seals will in most cases perform better under these circumstances.

Lip type seals are primarily used to seal against lubricants, or to seal against dry or fluid contaminants, providing ample seal lubrication is included in the design. If this type of seal is allowed to operate unlubricated for even a short time, considerable damage is done to the seal lip which may make it unsuited for further service. Inasmuch as the type of material which can be used in the sealing element can be varied, seals for certain special applications can be made. While leather was originally used in many seals, synthetic rubbers are now being used by many manufacturers, due in some cases to reasons of economy, and in other instances due to the lack of adequate physical properties of leather. Past experience has shown, however, that in several cases of back-up roll sealing where unusual conditions did not exist, the former leather seals were capable of lasting up to twice as long as some of our present day neoprene or Buna N seals under corresponding conditions.

This brings out a factor which must be considered in the selection of the sealing element material. Rubber is a relatively non-porous material, and in action against smooth steel surfaces will rub the surface comparatively dry. Thus, since the material holds little lubricant in its pores, the seal lip may wear, particularly if any localized lip pressures developed due to improper spring loading or other causes. Leather on the other hand, because of its ability to hold lubricant in its pores, will provide a measure of lubrication through these critical periods, and thus will tend to wear less rapidly. It is felt that this, in part at least, explains the longer life obtained by leather seals in many instances.

Leather seals are recognized as being satisfactory to a top temperature of approximately 230 to 240 F, while some synthetics are available for temperature ranges approaching 300 F or over. Higher temperatures can be sealed by the use of special elements, an example of which is a trial installation now in service using a silicone element operating in a spray drier at over 800 F.

For certain specialized applications where alcohol, acids, caustics, chlorinated, aliphatic, or aromatic solvents are to be either sealed-in or excluded, special elements are again required. Buna N will be required if alcohol or aromatic solvents are present. GRS rubber is best for acetone or weak acids, and thiokol is generally resistant to aliphatic and chlorinated and other active cold solvents. However, it will generally be

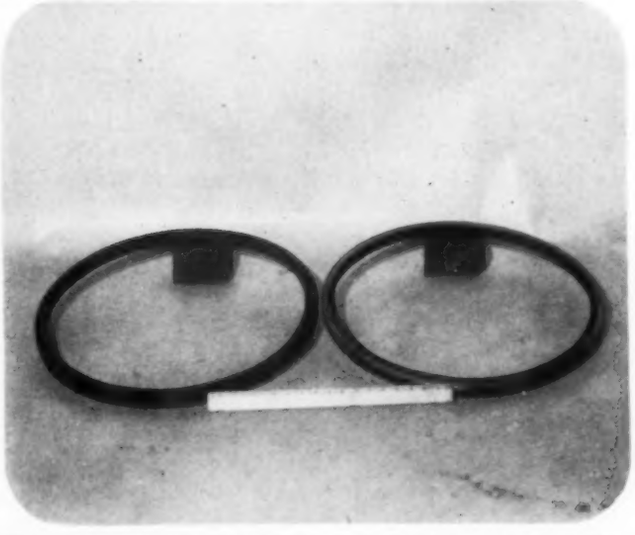


Figure 10 — On the left is a large seal using a garter spring. On the right is a design which uses a rubber lip as well as finger springs.

found that the expense of the special element will frequently make its use unprofitable and other methods of sealing should be considered. Suggestions for successful solutions to problems of this sort are advanced later in the paper.

Neoprene or leather elements under conditions such as these mentioned would usually fail in time, since neoprene will swell at various rates under the action of caustics, acetone, aromatic and chlorinated solvents and will harden with alcohol, while leather shrinks and hardens under the action of most of the materials mentioned and is destroyed by caustics.

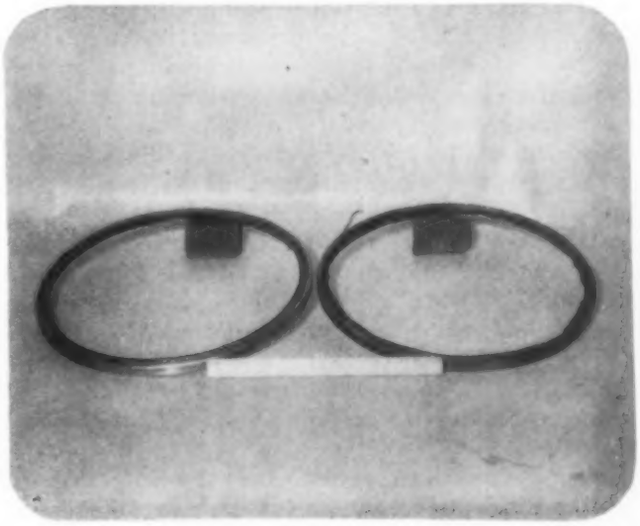
After the correct element has been selected based on temperature conditions and the materials to be sealed, the limitations imposed by the features of the seal assembly should be reviewed to determine the effect these have on seal efficiency and life. Presupposing the correct manufacturer's instructions for seal mounting such as the use of a pilot, etc., are followed and assuming the correct housing bore, correct method of mounting, and prelubrication of the contacting lip are also closely adhered to, there are certain other mechanical effects such as shaft runout, mating surface finish, shaft hardness, and operating pressure, all of which have considerable effect on seal life, and many of which can be controlled by the maintenance group.

Most mechanisms are designed to operate with small deflections and relatively no shaft whip, but invariably abnormal conditions develop which aggravate these variables. Normally, a shaft eccentricity of the order of 0.010 to 0.015 in (total indicator reading) for seals under 8 in. in diameter is accepted generally for spring loaded seals operating at normal speeds, with an 0.005 in. total indicator reading maximum for higher speeds. For non-spring loaded types, 0.004 in. total indicator reading is considered maximum for good performance. Generally speaking, the lower the shaft runout, the longer the seal life, independent of speed, size, or type.

For shaft conditions where eccentricity is not possible to eliminate, or where excessive shaft deflections are unavoidable, long lip seals (Figure 7) are available and will prove quite useful under certain circumstances. In most seals of this design, two garter springs are employed instead of one in order to guarantee the lip following the movement of the shaft without encountering the excessively high unit pressures such as would be encountered if only one heavy spring were used. Special units of this type are primarily made in larger sizes only. Other manufacturers use seal spring designs where the spring is wound with no clearance between coils and with high initial tension. These springs ride in a metal trace to reduce the snubbing action of the rubber on the spring, and by this means a better measure of control is obtained when wide deflections occur.

The condition of the surface finish of the mating part perhaps has more effect upon the efficiency and life of a

Figure 11 — This design uses a combination finger and garter spring with a rubber lip.



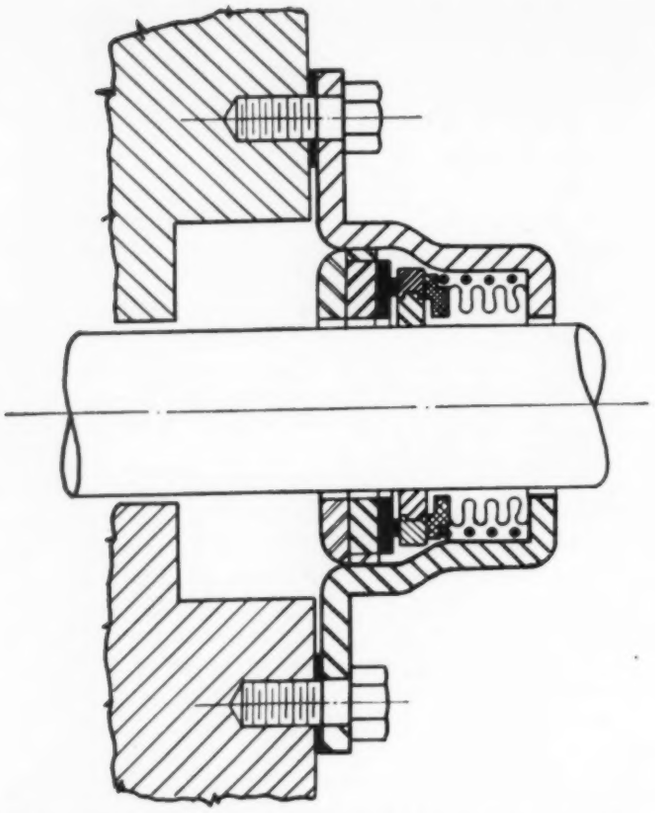


Figure 12 — Shaft finish is an important factor in the ultimate life of the seal.

lip type seal than any other factor. Rough finishes or a few bad scratches can destroy the sealing ability of a lip type seal in a relatively short period of operation. Specific finish recommendations are in order.

Using the root mean square, or as it is also known, RMS method of surface finish designation, maintenance personnel can control the finish of shafts and other wearing surfaces for lip type seals to the limits desired. The basis behind this system of surface finish measurement is that a stylus or tracer point moves over the surface under test, and registers the microscopic hills and valleys of the surface. The amount the tracer point moves up and down in terms of millionths of an inch as it moves across the surface is electrically computed and the root mean square average is indicated on a meter. This reading is known as the RMS reading for this surface. For most work, it is not necessary to actually test each surface, since comparisons of sufficient accuracy can be made against standard surface roughness specimens.

For efficient lip type seal operation and for adequate seal life, the user will invariably find that surface finishes smoother than 50 to 60 RMS are desirable for most surface speeds, with 15 to 25 RMS necessary for higher speed application. At 2000 to 3000 fpm, finishes under 15 RMS will usually be mandatory unless efficient lubrication and cooling can be provided. Scratches resulting from the press fit mounting of bearings, sleeves, etc., must also be carefully avoided on the surface contacting the seal lip if good life is to be obtained.

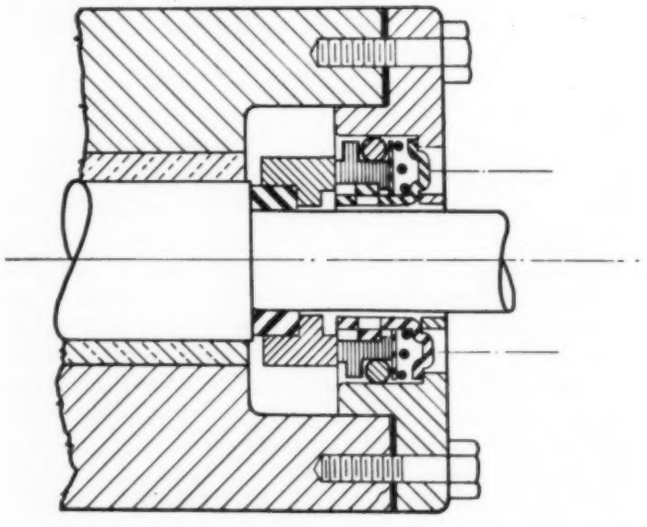
It might be well to mention that the RMS surface finish readings previously designated, refer to readings on the shaft at the seal interface just prior to placing the assembly into operation, and not as the shaft leaves the machine shop. By this, reference is made to the machinist who successfully obtains the necessary 35 RMS surface, but then promptly neglects to protect it with a suitable rust proofing material, with the result that the reading may be more nearly 100 RMS after the light surface rusting has taken its toll.

Surface plating in order to obtain a satisfactory mating surface for seals is gaining momentum. Experience on a number of applications has indicated that chrome or other hand metal plated surfaces will assist materially in extending seal life. The gain in this regard is three-fold, i.e., smoother initial finish, harder finish, and corrosion resistance. In addition, a further gain is experienced due to a lowered coefficient of friction which is encountered with some combinations of materials.

Shaft hardness should be sufficiently high to guarantee the retention of the surface finish initially provided. If soft shafts are resorted to, the seal will in time cut and gouge the shaft and thereby promote its own ultimate destruction. In order to prevent this action, a minimum hardness of 280 Brinell should usually be requested with higher hardnesses even more desired.

At the beginning of the discussion of lip type seals, the pressure retaining qualities of many of these units was indicated to be about 10 to 20 psi with special designs for higher pressures. If pressures are to be sealed continuously, the operating conditions must approach the optimum in all respects if long and efficient seal life is desired. Surface finish must be excellent with relatively no shaft runout. In those cases where pressures are not part of the original design requirements, the engineer and maintenance man should take positive steps to prevent the possibility of unnecessary pressures developing during operation. Temperature rise in the bearing or gear case during operation, or the oversupply of lubricant from a pressure grease gun are potential sources of trouble and must be properly taken care of by adequate venting. In all instances where these conditions may possibly exist, the seal should be

Figure 13 — In this figure, a sleeve bearing is being protected by a package type seal.



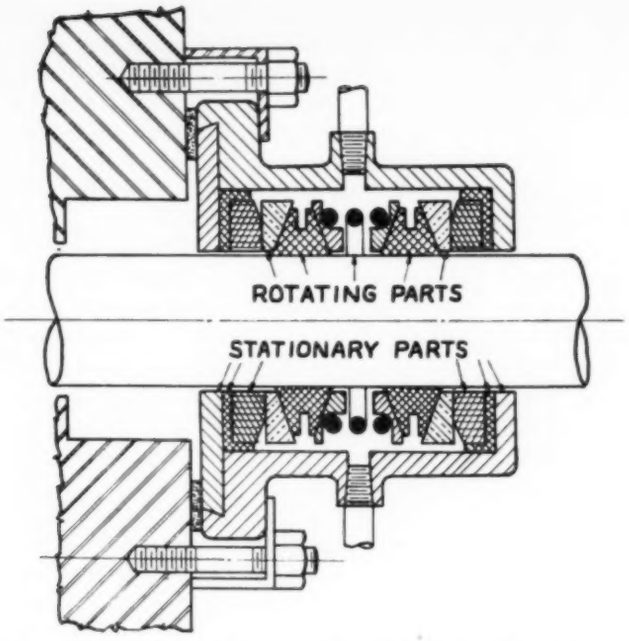


Figure 14 — The double seal design illustrated can be used where lubricants or coolants are circulated through the unit.

protected in order to prevent a shortened life. There are a number of satisfactory and inexpensive pressure vents on the market which can be installed by simply drilling and tapping the case or housing.

We have discussed in some detail the factors contributing to increased life and efficiency of typical lip type seals. Several illustrations showing a few of these practices in the large sized strip mill seals are available.

Figure 8 shows examples of these large sized seals. This represents front and back view of a 20 in. seal used on work roll bearings. Formerly these seals were duplex seals but experience has shown that decreased cost results if two single seals are used in place of the duplex unit. If either sealing lip is damaged, the single seal is discarded rather than the former entire duplex unit. Figure 9 indicates the spacer against which these seals operate. This particular unit is now grooved well beyond its useful life and must be replaced with either a rebuilt or a new unit. If this unit were reinstalled in its present state, the seals working against it would in all likelihood be rapidly damaged. Recent experience with chrome plating these spacers has shown materially increased seal life and is advocated for all new installations.

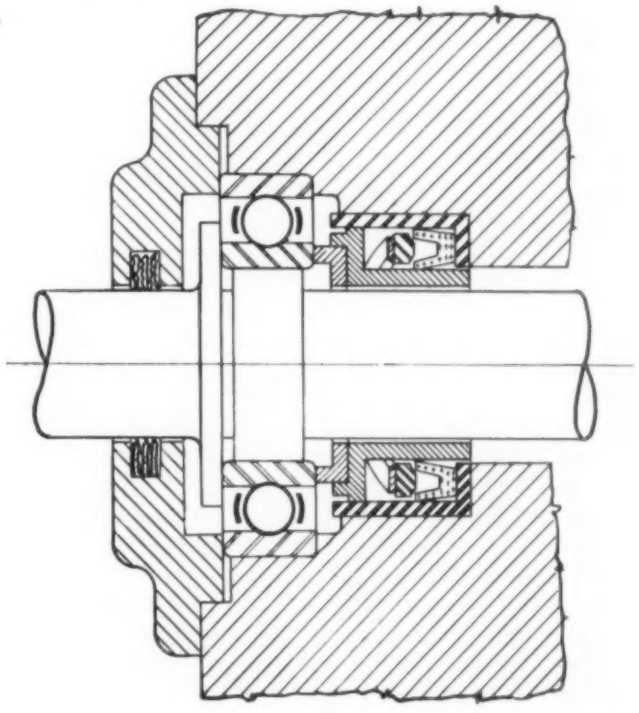
Figure 10 shows two types of large seals. The unit nearest the "one" mark on the ruler is a design using a garter spring for lip loading, but one which eliminates the metal case that normally encloses the seal assembly. Experience has shown that the seal material has had a tendency to become mushy in service and the assembly thereby loosened in its housing in the mill proper. It must be remembered that even neoprene and Buna N will either swell or shrink to some extent under prolonged exposure to mineral oils or water, particularly in constructions which incorporate fibre fillers. The seal nearest the "18" mark on the ruler is a design which uses a synthetic rubber lip and a steel case, but which also uses finger springs instead of garter springs for the lip loading device. This type of spring is found by mill experience to be more susceptible to damage from mill crews during mill changes than the garter spring design.

Figure 11 shows a recent design incorporating a combination finger and garter spring with a synthetic rubber lip and a steel case which again is found in mill experience to be susceptible to mill damage. Seal manufacturers in the face of evidence of this sort will usually respond with remarks indicating that more care should be taken by installation personnel. While this will certainly be granted in the great majority of cases, it is not an immediate nor a satisfactory solution. All those engaged in the maintenance of steel mill equipment realize that while it is a highly desirable objective to exercise care during the changing of rolls, this is not generally prevalent due to pressure to resume production, and that a more satisfactory and rapid solution to the problem is to employ a seal device that is less susceptible to damage.

Consequently it is not felt that these seals are the last word for strip mill service, whether the spring arrangement be garter, finger, resilient material or any combination of these three. Some experimental work has been done on other types of seal devices for these larger installations and these will be considered later in the paper.

As was stressed earlier in the paper, surface finish of the mating shaft is one of the most important factors controlling the ultimate life of the lip type seal, as well as influencing its operating speed and permissible working pressure. Considerable expense is necessitated in finishing and then preserving the finish of shafts, etc., for satisfactory seal performance. The need for a more simple control over this factor has been met by a number of packaged type seals which have now been placed on the market. Many of these include both of

Figure 15 — The seal ring of this design rides on the bearing inner race.



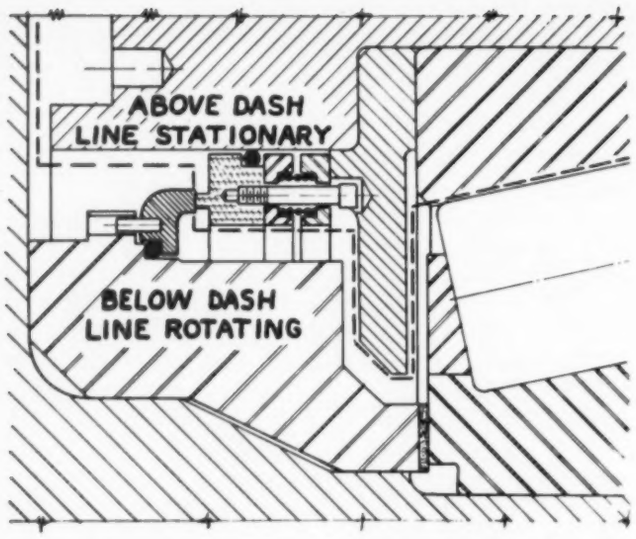


Figure 16 — The design shown is used on a strip mill.

the sealing surfaces integral with the assembly. Figure 12 shows a typical unit of this type where the seal is being used as a pump shaft packing. In this assembly there is a double end face seal with lubrication built directly into the unit so that the surfaces will operate satisfactorily in dry or dusty conditions or in some cases against nonlubricating fluids.

Figure 13 indicates another manufacturer's unit operating as a seal for a sleeve bearing. In this installation, the main section of the closure is stationary and seals against a floating seat. This permits greater flexibility and assists in maintaining the seal surfaces in good alinement. It will be noted here that the seal is actually in two pieces rather than a unit assembly. The nature of the installation will in most cases determine whether the true packaged unit is necessary or whether the two piece assembly is more suited.

The general construction of this design of seal includes a sealing washer operating against a seat. The seat is usually a metallic material suited to the specific needs of the application. If no particular problem is presented, nitralloy or cast iron is frequently used, although bronze, stainless steel, nihard, stellite, ceramics, or hard organic compounds are at times used. The seal ring is usually a carbon base compound, although hard steel, bronze and other materials are available if necessary.

Static sealing is accomplished by various methods in different designs. Press fits, "O" rings, special synthetic rubber shapes and diaphragms, and gasket materials are used, depending on the design and the materials to be sealed. Most designs employ either coil or flat wave springs to develop the necessary seal seating load, although for higher pressure units, the pressure itself is used as the major seating force.

Due to the wide variety of designs available, most materials can be sealed. For those requiring additional lubrication, double seal designs (Figure 14) can be used where lubricant or coolant can be circulated through the unit. It should be remembered that oil or grease need not always be considered as the lubricant due to the possible combination of materials in the seal surfaces. In certain marine installations, salt water has proven to be quite adequate as the circulating fluid. The unit shown in this figure is replacing a conventional packing gland type of shaft seal. A factor in favor of units of this type over packing glands is the power saving due to decreased friction.

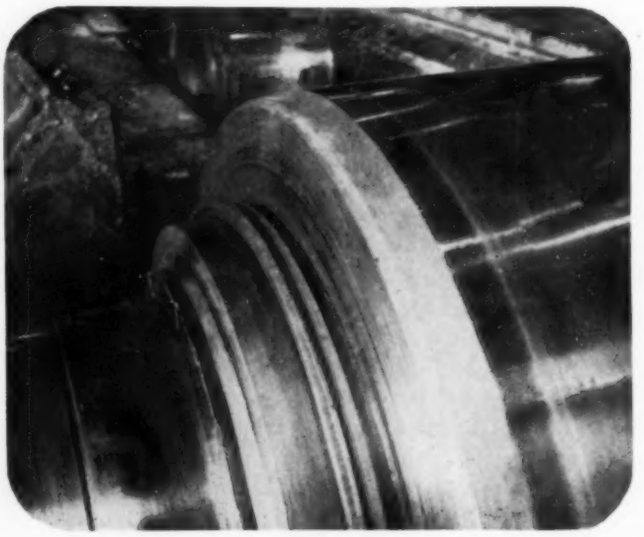
Figure 15 shows an installation where advantage is taken of the excellent surface usually provided on antifriction bearing parts. In this case, the seat part is eliminated and the seal ring rides on the bearing inner race. This is usually not as satisfactory as the complete seal but serves quite well in many applications.

Seals of this general end face closure design are satisfactory for use on vacuum installations, and for various pressures depending on the method of mounting and the particular type of seal design. Most designs using the indirect type of mounting, where the pressure acts against the spring, are satisfactory for installations involving pressures to about 40 psi. If the direct mounting of the seal is used, where the pressure acts in the same direction as the spring load, the seal will generally be satisfactory to approximately 200 psi. Special designs using balanced pressure on the seating surfaces and other modifications, are satisfactory up to 1000 to 1500 psi. However, at pressures in this vicinity and above, the static sealing members of the seal assembly will usually fail unless careful design is followed.

High speeds are possible with this type seal providing high pressure is not also a factor. A speed of 3000 to 4000 fpm can be satisfactorily handled by most designs, with 8000 fpm possible with special seals having narrow contacting surfaces, light spring pressures, and good lubrication.

The temperature that can be safely handled depends to a considerable extent upon other working conditions of the seal, particularly pressure. Since many of the synthetic rubbers are limited to 300 F, the static sealing members of the seal assembly frequently are the parts that will limit the seal working temperature since the seal ring and seat can be made of heat resisting materials. However, if a design does not require synthetic rubber "O" rings or other sealing members and uses only press fits, or if materials such as teflon can be employed as the static seal ring, temperatures of

Figure 17 — The cast iron floating seat member of Figure 16 is here shown mounted on the roll.



500 F are readily within the scope of these seals. Needless to say, maximum temperature and maximum pressure or speed cannot be sealed by the same unit.

The size of stock units of this type seal varies between several of the manufacturers, but a range of about two-tenths of an inch to 5 in. are generally available in most designs. In addition, some manufacturers are now providing special designs going over 4 ft in diameter for use on strip mill applications.

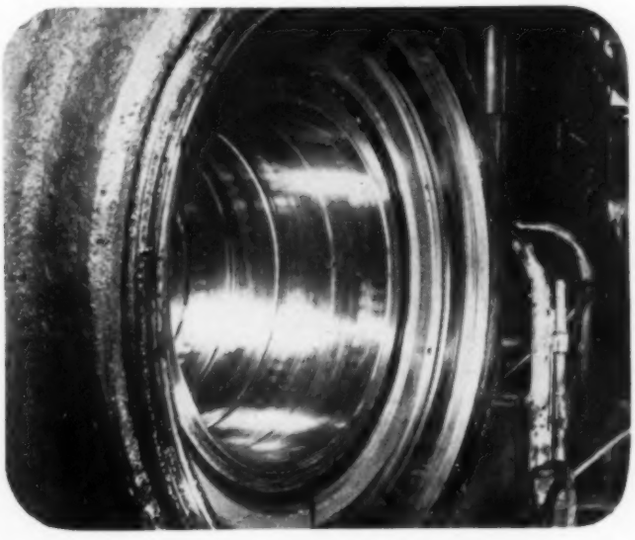
Figure 16 shows an adoption of this type design to a strip mill. In this instance the floating seat is machined from cast iron and the seal ring is fabricated from a carbon base material. End play to the extent of $\frac{1}{8}$ in. has been provided for in this design, although amounts up to $\frac{3}{4}$ in. have been included in various other installations.

Figure 17 shows a view of the roll with the cast iron floating seat member mounted thereon and Figure 18 shows a view of the spring loaded seal ring mounted in the housing.

Other large installations using this type of seal in addition to hot and cold strip mill back-up and work roll bearings, have been vertical edgers, large centrifugal casting machines, etc. Experience to date with end face sealing has shown considerable success and new applications are in the process of trial.

Up to this point, contact sealing in various forms has been considered exclusively. No discussion on seal devices would be complete without at least a brief mention of proximity sealing. Figure 19 indicates a labyrinth seal and crown ring mounted so as to seal a plain bearing. This labyrinth seal is also fitted with an external water flinger to prevent entry of dirt and water, as well as to prevent loss of lubricant. Seals of this type are not as efficient as many of the types previously mentioned since small clearances must be allowed between the labyrinth combs and the shaft and at the crown ring. However on higher speed, precision machinery, these seals are quite effective, particularly if the equipment is in steady operation having relatively few stops. Comb clearances of approximately $\frac{1}{2}$ to 1 per cent greater than the bearing clearance are common. Comb materials are usually of the softer metals in order to prevent cutting of the rotating member.

Figure 18 — The spring loaded seal ring of Figure 16 is here shown mounted in the housing.



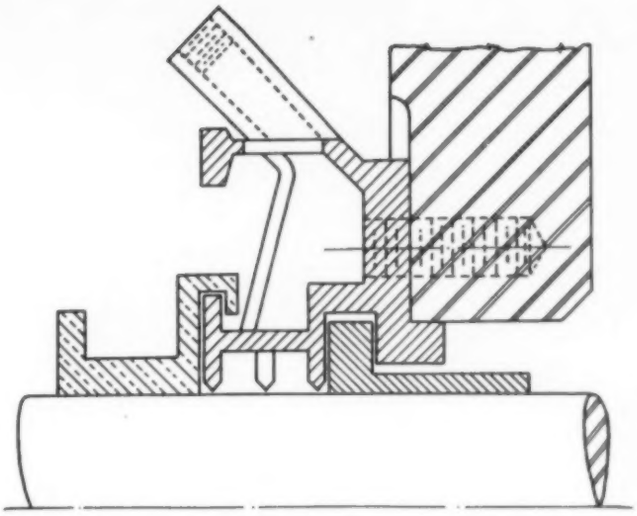


Figure 19 — This labyrinth seal is mounted so as to seal a plain bearing.

In summary, it can be said that proper sealing of bearings, gear cases, and similar equipment affords maintenance personnel a means of combating the damage that is continually being caused by the entrance of solid and fluid contaminants into the lubricants serving these moving parts. In many cases, simple devices such as felt dust seals and oil retainers installed directly in the field will provide satisfactory protection. In other cases, the more expensive, more accurately engineered felt seals, or end face or lip type seal may be warranted, but in all cases where dirt and contamination is a problem, adequate sealing must be included or repetitive and costly replacement will result.

When pressure retention is encountered, precision sealing must be employed or leakage, clean-up expense and fire hazard are reoccurring problems.

DISCUSSION

PRESENTED BY

L. G. KRUG, Chicago Rawhide Mfg. Co., Chicago, Ill.

F. H. JUDGE, District Manager, Western Felt Works, Cleveland, Ohio

HOWARD TAFT, Crane Packing Co., Chicago, Ill.

R. A. KRAUS, General Millwright Foreman, Republic Steel Corp., Chicago, Ill.

NORWOOD I. WHITELY, Lubrication Engineer, American Steel & Wire Co., Cleveland, Ohio

ANDREW CICHELLI, Lubricating Engineer, Bethlehem Steel Co., Sparrows Point, Baltimore, Md.

L. G. Krug: Mr. Kraus wrote his paper from the standpoint of maintenance and seal replacement. The

facts mentioned could only be apparent to one who has had seal installation experience. All the statements made were correct to the best of my knowledge, and some of the recommendations such as those on the grade of felt to use should be a real guide to all of us.

In the paper, mention was made of picking the best seal for each application, this to be done by keeping up with new developments. There is one difficulty to this procedure. The machine manufacturers never allow sufficient room to install a good seal. Most design engineers consider the seal as the last item on the program and seal manufacturers are lucky if they get ½ in. square cross section for seal application. Men in maintenance are not only limited by lack of space, but in addition, can do almost nothing about making a correction. The seal shown in Figure 7, the long lip seal, is a good example. With a seal lip of 1½ in. and two garter springs, shaft runouts of as much as ¼ in. total can be accommodated. How can a seal 1½ in. wide be installed where only ½ in. width is provided? With the long lip seal it would be possible to protect sleeve bearings until they are almost worn out and still do a good job of sealing.

In another portion of the paper, recommendations were made, and correctly too, for various compounds of synthetic rubber. You will note that the term "compounds of synthetic rubber" was used. I would like to say just a few words on the subject of synthetic rubber. Most of us know that there are various brands on the market, thiokol, hy-car, neoprene, Buna, etc. These names all refer to a raw product which before use must be compounded. Each manufacturer has his own formula which he developed through research and tests. My company may produce a good seal with hy-car compound while a competitor may use neoprene. What I am trying to say is, that the success of synthetic rubber seals depends almost entirely on the compounding.

During this exposition, I have had many people speak about graphitic synthetic rubber. There is no such thing. In compounding, up to 8 per cent graphite or carbon may be used, but if more is introduced, one cannot secure a proper compound. It is just like making a pie crust. Flour is added, but only a definite amount. If more is used, the pie crust falls apart. In compounding synthetic rubber, the graphite or carbon does not give any lubricating quantities to the compound. Synthetic rubber seals and packings are not self-lubricating and must be lubricated from an outside source.

In Figure 10, a seal was shown without a metal case. These seals should not be used indiscriminately. The proper installation is made by clamping the seal front and back. If not clamped, it will turn in the bore and leak around the back of the seal. On rolls with oil grooves and bearings using brass rings in slots, this block type or nonmetal encased seal works very nicely.

Producers of oil seals, especially big seals for mills, are always striving to better their product. We all agree with the statement of Mr. Kraus that "present seals, whether garter, finger spring or combination of both, whether rubber or leather, are not the last word. Much work in new and different designs is going on at present, and may be ready for report and test in the very near future."

F. H. Judge: In his paper, Mr. Kraus brought out one point that Mr. Krug also emphasized in his discussion, one that I am sure is well understood by many of you. It is the importance of the inter-face finish, the finish of the shaft or sealing surface at the point of contact with the seal, whether the motion be reciprocating, rotating, or oscillating.

This matter has not been given the care and forethought that is due it. Many engineers have learned that a little extra money spent to refine the sealing surface, or the inter-face finish, pays good dividends in a reduction of service and replacement expense.

My experience with bearing seals covers approximately thirty years, and goes back to the time when there were few, if any, good seals. All during these years there has been a problem of persuading engineers, particularly design engineers, of the benefits to be had from good bearing seals, and the absolute necessity of providing sufficient space for them. Sometimes it seems necessary to practically "club them over the head," so to speak, to get them to "see the light," and, even today, we find too many instances of this lack of understanding.

I have close contacts with two or three other groups of engineers, am a member of several, and, no matter how hard you "hit" some of them, they seem to lack the sincere desire to incorporate a really good sealing device to protect bearings.

In too many instances, designers will set up a layout for an excellent bearing and make little or no provision for a seal. And, if a seal is provided for, frequently it is the cheapest that can be devised, regardless of efficiency.

The steel industry today uses probably more of the large and very costly bearings than perhaps any other industry, and the costs incidental to shutdowns due to bearing failures are very high. So, to engineers in the steel industry, I would emphasize what Mr. Kraus has said, it is imperative that you put pressure on your design engineers to pay more attention to the provisions for good bearing seals.

As far as felt seals are concerned, we make that type, of all sizes and qualities, and of plain wool felts as well as of combinations of laminations of wool felts and synthetic oil-resistant rubbers. Layers, or laminations, of oil-resistant rubber with the felt act as positive dams to prevent leakage of lubricant from a bearing, while the felt itself acts as a dust and grit seal and, at the same time, through its absorption of some oil or grease, the felt lubricates the sealing surface and reduces friction.

We also make a wide variety of bearing seals from synthetic rubber compounds, the actual function and the conditions of operation of the seal being the determining factors in the selection of the compound to be used for each individual job, as well as in the selection of the proper design or type of the cross-section shape and size.

There are many places where seals of synthetic rubber should be used for the greatest efficiency, particularly where pressures are involved.

In connection with the use of a synthetic rubber seal, I think consideration should be given to the use of a separate felt seal for the exclusion of dirt, dust and

other foreign matter, and for the additional purpose of providing some lubrication on the sealing surface of the shaft. Experience has shown that it is quite effective. I would not say it is 100 per cent effective, but a great deal of good has been accomplished by the use of such a felt seal outside of the long-lip seal, or the short-lip seal, or whatever type is being used. That, I repeat, should be given consideration.

The felt seal that Mr. Kraus showed in Figure 2 is a very simple one, and it is one that we would like to get away from for a great many reasons. It has been proved that a piece of felt used as a bearing seal should get a compression at the "back end." In the assembly there should be a tapering at the back of the seal, that is, a reduction in the thickness of the felt, so as to bring the fibers bearing down on the shaft in such a way as to round them over on the sealing surface, thus providing a compression that is carried on for a great length of time through the natural resilience of the wool fiber.

Howard Taft: Packing, as you know, has been in popular uses for many years and, if properly selected and applied, will usually do the job required. Packing is generally associated with pumps, compressors, hydraulic cylinders, and other units of a similar nature. Popular as it has been, it is being replaced by end face type seals on many different types of service, such as pumps, compressors, etc. The advantages are obvious, no leakage, no replacement, no adjustment, and long life.

The lip type seal, like many others, derives its effectiveness by the simple means of correct application and installation. As Mr. Kraus pointed out, shaft deflection, finish, hardness, speed and temperature, all have a direct bearing on the life and functioning of the seal.

The lip type seal manufacturer builds the seal to the best of his ability. The materials used are the results of tests and experience on the various applications. The component parts are checked and inspected, it is carefully wrapped and packaged for dust-free delivery. In short, it is as near perfect as it is possible to make it. However, to make this type seal function, the mill builder, if it is a piece of new equipment, must furnish the matching part, namely, the seat. If it is a service replacement, it usually falls to the maintenance department to furnish the seat. This seat may be a shaft, spindle, sleeve, neck, or possibly a gear hub. Whatever the seat may be, it should have a finish of 15 to 60 RMS, depending on speed, pressure, etc. All too often, the average machine shop is not equipped to produce these ultra lapped finishes, and the seal may be installed on an inferior seat. The result is premature failure and ineffectiveness. The responsibility for proper functioning has been divided. The modern end face type seals, shown on the figures, are what may be termed a package seal. Here we have a seal together with its seat ready to install as a complete unit—no special finish on shaft or sleeve required, and no close tolerances to hold on diameters. The sealing faces on both seal and seat are machined and lapped to a flatness of 2 to 4 light bands and finished down to 6 microinches on the smaller high speed applications.

Seals of this type are successfully used on pumps, handling practically all of the liquids encountered in steel mill operation. They are used on vertical edgers, run-out tables, gear drives, reducers, coilers, roll necks and many other applications. They are easily and quickly installed, simple, built to rigid specifications, and matching parts are interchangeable.

Its application to roll necks permits an extremely easy assembly and disassembly of the chocked bearing. The seal seat is usually pinned on to the roll, or thrust collar, and remains in that position during roll grinds, inspection, etc. The balance of the seal is held securely within the back face of the bearing chock and statically sealed on the outside diameter by means of a suitable "O" ring. This part of the seal remains in the chock at all times, but is easily removed and replaced in position.

In stripping the chock from the neck the usual shop procedure is followed, the seal merely parts at the sealing faces. On assembly no special tools or adapters are required; the chocked bearing is lined up to the neck, and mounted. The seal faces are then in proper contact for the application. It is positive under neck deflection, looseness, and endwise movement of the roll.

Member: Mr. Kraus in his paper made reference to asbestos as used in packing materials. I would be interested, first of all, in hearing his opinion as to why asbestos in some instances appears as soft fibrous material, whereas in other instances the asbestos is a harsh material.

Secondly, where chemical resistance is a prime factor, why is the blue type of asbestos preferred?

R. W. Regan: Mr. Kraus mentioned something about teflon being exceptionally good in the presence of acids and caustics. I was just wondering what teflon was and what are some of its outstanding characteristics.

R. A. Kraus: In regard to the questions about the harshness or softness of grey asbestos, we will find the answer in the chemical composition of the material. Grey white asbestos is composed approximately of the following material:

MgO	39	to 44 per cent
SiO_2	39	to 41 per cent
Al_2O_3	½	to 2 per cent
FeO	½	to 2 per cent
Combined H_2O	10	to 17 per cent

The range of 10 to 17 per cent on the combined water controls the extent of harshness of the fiber. If the combined water content is 10, 11 or 12, the asbestos is quite hard and brittle. As the water content increases and approaches 15 to 17 per cent, you get the very soft, fluffy grades of grey asbestos. If during service we expose the asbestos to extreme heating, we drive off the associated or combined water and reduce the percentage toward 10 per cent with the result that the material will become more brittle and frequently break up in service.

Blue asbestos is commonly used on packings where chemical resistance is an important factor. Grey asbestos is considerably better than blue asbestos where temperatures are a factor, but the blue asbestos is more chemically resistant. The reason for this is also a chemical one, in that the blue asbestos composition varies considerably from that of grey asbestos.

It is somewhat like comparing common steel and stainless steel; they are both called steel although the composition is quite different.

	Typical grey-asbestos per cent	Approximate blue-asbestos per cent
MgO	41	2
SiO_2	41	51
Al_2O_3	1	..
FeO	1	36
Combined H_2O	16	4
Na_2O	..	7

You will note that the rule of 14 to 17 per cent water does not hold for this type of material, but that 3½ to 4 per cent is a better figure for a good grade of African blue asbestos. This product will disassociate at a considerably lower temperature than the grey white type of asbestos.

In regard to the question on teflon, we can say that it is a thermoplastic resin produced by one of the largest chemical manufacturing companies. It has usefulness to approximately 500 F, although the company recommends 450 F, and I have heard of applications where 550 F have been tried. The top working temperature is, of course, a function of the nature of the application. The product is a white waxy material which can be molded and machined under certain conditions. The principal use is for packing gland material and gaskets, although it is being used experimentally for lip type seal elements and other uses.

Its chief advantage is its almost complete chemical inertness inasmuch as it is affected only by the molten alkali metals. It is completely resistant to all organic solvents, acids, caustics, etc.

Norwood I. Whitely: I wonder if Mr. Kraus or any seal men have had any experience with spring-loaded type seals on shafts or drive shafts of nail machines. Practically all of the machines that I have been familiar with are sealed with felt seals laid in a groove which very shortly starts to leak. I have been going to do some experimenting with spring loaded seals. Of course, there is no room for them, as was mentioned here before, so you would have to cut out the diameter to allow for a seal.

What effects could be expected considering the vibration prevalent?

F. H. Judge: Mr. Chairman, I wonder if this gentleman has used combinations of felt and synthetic rubber on those machines?

Norwood I. Whitely: Practically all of them are felt all the way through.

F. H. Judge: There are some nail machines used in the east that used seals made of a combination of felt and a certain type of synthetic rubber laminated, and those seals have been reordered at various times. The report came back that they were very successful. I do not know just where those machines are, but they were somewhere in New England. I initiated the use of these seals a number of years ago. Perhaps someone here could tell you where these nail machines went and how they are working now.

R. A. Kraus: Without seeing the equipment or the seal it would be difficult to recommend corrective measures. The fit of the seal or the grade of felt may be partially at fault. If the felt alone will not work satisfactorily after selecting what should be the proper type, then in order to avoid remachining for a different type of seal, the laminated felt and rubber type should be tried. If this also does not work, then remachining for a different type of seal may be necessary.

Andrew Cichelli: Mr. Kraus mentioned chrome-plating of a surface so that the rotating elements would rub against a chrome-plated surface rather than against steel or cast iron. We have tried that at Sparrows Point in several installations, and have been quite successful. In one instance, we increased our packing life five to one. It happened to be a pump sleeve job, the same as a bearing seal for all practical purposes.

L. G. Krug: The question came up as to why leather seals worked satisfactorily when they were first introduced and now they seem to be entirely out of the picture. This leather replacement with synthetic rubber is almost entirely due to steel mill operators using an alkaline coolant on the mill. Alkaline solutions are very destructive to leather, yet do not affect synthetic rubber.

Another point brought up was the use of silicone rubber in high temperature applications up to 800 F. This is possible if the silicone is used in a confined position such as a gasket in a groove, but if used in open condition, as in a seal, 300 F is about the top limit.

On Figure 16 was shown a large end face seal. Is it possible to lap this surface to a two to four wave band tolerance at a reasonable cost? If this can be done the mills are certainly doing a better job than has been done before. I have heard many definitions of light wave bands. Now I would like to know if somebody can give an idea as to just what is meant by a two to four wave band finish.

Howard Taft: A light band is 11.6 millionths of an inch; and irregularity is determined by an optical flat, that gives you the amount of concave or convex of the piece under test in millionth of an inch. These are read between the curved bands on the optical flat. You will recall, Mr. Krug, that I made the statement that we often held the seal surfaces to four light bands in flatness and to six micro-inches in finish on small applications. That includes seals up to five or six in. diameter.

On small seals, say inch to inch and a half in diameter, we reject everything over two light bands, and let the micro-inch reading fall where it will. Usually that is under six micro-inches.

On a large steel mill seal in the neighborhood of 34 in., it is obviously impossible to put an optical flat on it, because you have to have a flat as large as the piece you are testing.

In these cases we grind and lap usually with cloth and do the best job that can be done with this large piece of material. It is not down to six micro-inches, or if it is, it just happened, that is all. As a matter of fact, the very refined finish is not required for average conditions, but for high speeds and where you have high pressures, say, up around 1000 to 1500 psi, where these finishes are highly desirable.

Andrew Cichelli: Have you ever tried fabric materials for roll seals?

R. A. Kraus: Yes, the difficulty with fabric materials for roll seals in steel mill service is the amount of scale that is encountered. Unless you can prevent the scale from chewing out the fabric, you will have a comparatively short life. On some jobs we have found that a leaded bronze seal ring works as well as anything under these conditions.

MAINTENANCE SYMPOSIUM

On Present Day Production Systems

By VIRGIL FRAZIER
Assistant to General Works Manager
Great Lakes Steel Corp.
Detroit, Mich.

. . . . the superb production record rolled up by the steel industry was aided by a good maintenance program, properly planned and ably executed . . . .

▲ "INTELLIGENT planning and maintenance must obviate the need for production miracles," such was the expression of Mr. Charles E. Wilson, president of General Electric Co. Few statements more adequately define the critical position of maintenance in present day production systems. The vast expansion in man's mastery of materials has presented through the years and continues to present many formidable problems; problems requiring of the greatest resources and combined forethought as well as superior science.

An examination of our accomplishments and our prospects in the realm of material industry reveals a signal honor rightfully due the maintenance phase within the vital and critical foundation industries of our economy.

The extreme complexity of present day maintenance, having resulted from the high state of integration of modern industry, not only requires the most exacting mechanical evaluation but also the compelling recognition of the basic and fundamental science of metallurgy.

Probably no factor presents more difficulties or exerts more influence upon sustained high level operations than plant maintenance. During such periods maintenance must not only anticipate and prevent interruptions, but it must be scheduled to the most exacting detail so that when and if unit breakdowns or shutdowns in one department do occur, the necessary repairs can be made simultaneously to other complementary equipment in the department.

That tremendous effort has been expended to provide means with which to reduce the time required for major repairs is attested to by the weeks of operating time saved in the recent records established in blast furnace relining, also the many days of production operations which have been saved in the rebuilding and repair of open hearth furnaces, soaking pits, rolling equipment, etc. These tremendously valuable savings can be realized only where proper maintenance planning and scheduling have provided the required material and manpower.

Further, the installation of auxiliary equipment to facilitate operations has placed additional burdens on maintenance. This maintenance has a dual problem, that of maintaining equipment in continuous working conditions until repairs are scheduled, and that of minimizing the time for such repairs.

During high level operations, the allocation of primary product and the scheduling of mills to required product without loss in finished production are problems of first magnitude and emphasizes the importance of an efficiently functioning maintenance unit. The solution to these vital maintenance problems involves developing and coordinating a multiplicity of major factors and seemingly unrelated minor factors to fulfill the requirements of each department together with equipment and manpower.

Any general maintenance organization must for expeditious reasons be as highly integrated as modern day industry. Each division of a general maintenance organization in turn must also be so constructed with such specific personnel as to adequately provide for the required mechanical and engineering skills.

To present a complete cross-section of the maintenance aspects in the vast field of major industry would not be possible in a single symposium or writing. The sub-divisions of the symposium this evening are:

1. Crane Maintenance.
2. Cold Mill and Pickling Equipment Maintenance.
3. Boiler Maintenance—Feed Water Treatment.
4. The Metallurgy of Steel Plant Maintenance.

They represent but four of the major phases in the steel industry. Of these divisions, the metallurgy in steel plant maintenance is relatively new, but will be found to be of such proven value that the future of

Presented before AISE Detroit District Section Meeting, April 12, 1949

metallurgical science in the field of industrial maintenance is most assured.

It has been stated that the economy in industry depends upon the efficiency of its equipment, such a statement might well be qualified to include the efficiency of maintenance systems.

In industry generally, maintenance can review with satisfaction the difficult asssignments which have been carried out with excellent records and look forward to the future with confidence that still greater demands will be made.

CRANE MAINTENANCE

By J. M. RICHARDSON, General Foreman, Crane Maintenance, Great Lakes Steel Corp., Detroit, Mich.

I will attempt to show the importance of the electric overhead traveling crane maintenance department at Great Lakes Steel Corp. In this department we are responsible for the mechanical and lubricating maintenance of all overhead and floor cranes, consisting of the following:

1—300-ton ladle crane, double trolley.
3—250-ton ladle cranes, double trolley.
3—200-ton stripper cranes.
4—125-ton hot metal cranes.
4—10 to 15-ton pit cranes.
111—5 to 75-ton mill type cranes, some of these are equipped with two hoists.
3—gantry cranes.
25—1 to 5-ton jib cranes.
8—Floor chargers.

Total 162—Cranes.

The cranes are distributed in the various departments. In our open hearths we have our heavy-duty cranes, which consist of 300-, 250- and 125-ton metal carrying cranes. The steel is charged into furnaces by 7½-ton charging machines. On the charging floor we have the 125-ton hot metal cranes that are used to pour the bessemer molten metal into the open hearth furnaces. Later the furnace is tapped into the ladle in the open hearth pit, this ladle being handled by either the 250- or 300-ton ladle cranes. The approximate weight of the ladle and molten steel is 375 tons. These cranes are used in pouring the metal into molds. After the steel and molds are cooled, they are moved into the stripper building where the stripper cranes strip the ingot out of the molds in preparation for the soaking pits. These stripper cranes are of 200-ton capacity. Of the three stripper cranes, one is of a universal type, which we can either push or pull the ingot out of the molds, while the other two cranes can only push ingots out of molds. At the soaking pits, the ingots are handled by the pit cranes of 10- or 15-ton capacity. The tonnage of the ingots varies from 5½ to 16 tons. These cranes are used for many purposes besides handling ingots, such as: carrying coke, cleaning up floor scrap with magnets, etc. The heavy-duty mill type cranes are of 75-ton capacity, having a 75-ton main hoist and a 25-ton auxiliary hoist. The cables on these cranes have a safety factor of 6. While these cranes are mostly used for general mill work and changing of work rolls, when handling back-up rolls a jig must be used. Approximate weight of roll and jig is 81 tons. Other cranes, varying from 60- to 1-ton capacity, single and double hook, are used for all other mill operations.

CRANE MAINTENANCE PROBLEMS

Overhead crane repair maintenance has many problems. Work of this phase is probably the most hazardous maintenance work in the steel industry. Most all work performed by this department is of an overhead nature. Space allotted for work of this type is generally inadequate, which usually requires rigging or scaffolding. This tends to slow down repair work and runs into operating delays, and is a bad condition, especially today when the steel industry is producing at its peak. One of our serious problems is the inability to do preventative maintenance. We know this is a bad condition. We realize that the production departments are very anxious to produce great quantities of steel because this is their business, however over a period of time, this practice of not maintaining at the proper time is very expensive. And in an overall picture, the added cost of parts to repair or replace this equipment is exorbitant. Every machine, no matter how small or how large a part it plays in production, should have at regular intervals a downtime for maintenance. This has proven to be the least costly and the more productive system of all. Preventative maintenance is probably the greatest money-saving factor a business has, and probably the least followed.

Lubrication plays a large part in the maintenance picture. No one phase is as important to good maintenance as correct lubrication. The many cranes use various types of lubricant. To get the correct type of oil and grease is very essential. In order to maintain a good lubrication schedule many things must be taken into consideration. For instance, some cranes require more lubrication than others. Some operate in high temperatures, while others have excessive work to do, with overloading and fast operation. Some cranes have all these bad factors. This makes a difficult lubrication problem. Most of these conditions we have overcome, while others are still in the experimental stage. We employ twelve men in this work, using one lead rigger and eleven oilers. Their lubrication schedule covers the entire plant in three weeks.

Another important phase of our work is the rigid inspection schedule. This is done by four overhead crane inspectors. Their schedule rotates through the plant in periods of three to four weeks. The men serve two purposes; first, to observe any unsafe conditions overhead, secondly to find worn parts that can be renewed before major breakdowns are encountered. This phase of the work has proven very satisfactory and is

of vast importance to both safety and preventative maintenance.

THE CHANGE IN MAINTENANCE PROCEDURE

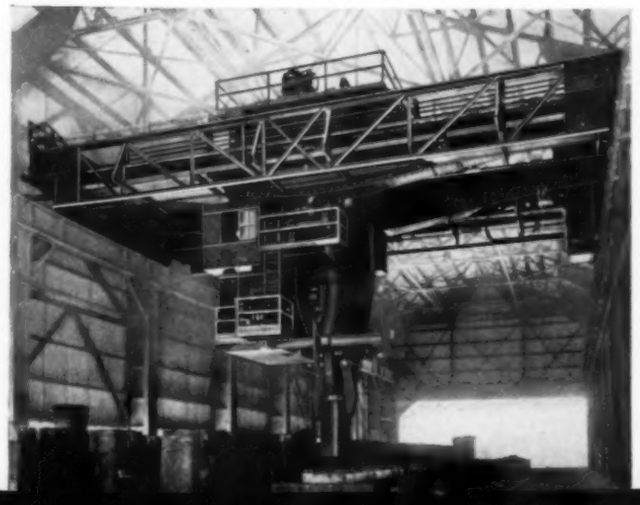
The maintenance of 162 units of such different capacities and of different designs requires a vast amount of spare parts. We employ an expediter who does nothing but follows our spares, such as planning future needs and keeping record of the location of each spare part to expedite fast repair jobs and reordering of said parts. He also follows the repairs to equipment through the shop and supervises their transportation to the proper location. This system has proven to be very efficient and pays dividends.

The cables which we have in continuous operation, if laid end to end, would stretch for sixteen miles. These cables vary in size from ¼ in. diameter for jib cranes to 1½ in. diameter cable for the larger cranes. We have approximately 800 bridge track-wheels in continuous operation. These wheels vary in size from 12 in. diameter to 36 in. diameter. The wheel shafts are equipped with both brass and anti-friction bearings, the majority of ours being anti-friction bearings. These cranes and chargers are equipped with worm gear drives on most hoists, while others are equipped with spur gear drives. We have in operation 144 hoist worm gear drives and 41 spur gear drives.

To maintain this equipment we employ 105 men in this department. This includes foremen, lead crane riggers, overhead crane inspectors, riggers, oilers, helpers, expediter and a clerk. Each has his respective responsibilities. This crew is broken down into three turns per 24 hr, and operates seven days per week.

I believe we all recognize the ever present value of spare parts. It is, in all probability, the best insurance for full production maintenance. It seems to me that we are fast changing our maintenance procedure. The time is past when mechanics felt the full responsibilities of their jobs. Today we have a condition which amounts to the following: most maintenance work revolves around two things, first the foreman, second the spare parts on hand. There was a time when the mills had sufficient downtime for maintenance. Today with production schedules up over 100 per cent this is not possible. So, to overcome this difficulty, we have only one way in which to proceed, that is to have the job revolve around the foreman, and have easily accessible spare parts. This will give the necessary time saving factor to keep production at its present level.

Figure 1 — Successful continuous plant operation requires dependable crane service.



MIS-USE OF EQUIPMENT

The mis-use of equipment today, both from worker's carelessness, and some of the work required by production, is a very costly item to any business. It constitutes a very serious problem for maintenance, inasmuch as there is no way in which to plan future repairs. Most of these bad practices are carry-overs from wartime production. It will take an effective educational program to remedy this condition. One of the future conditions that will overcome mis-use of equipment will be the change-over from a seller's market to a buyer's market. Competition will soon make an effectual difference in cost of maintenance.

CRANE MAINTENANCE IN THE SAFETY PICTURE

Overhead crane repair probably involves more safety than any other one department. This applies not only to the work involved on the particular job, but also to the men on the floor. Every overhead job has potential safety hazards to the people working under the crane. For instance, if every part is not securely bolted or riveted overhead, then the possibility of something falling off of the crane onto the floor would certainly cause considerable damage. It has been the policy of supervision in this section to continually remind and point out the importance of each man doing his job to the best of his ability, both for the welfare of his fellow workers and himself.

In conclusion let me say that in an overall picture of the steel industry, overhead cranes play a very major role in peak production. But to keep this major role, good efficient maintenance is important. And to do a good job of maintenance we must follow these rules: keep good records, adequate spares, proper tools, proper lubrication, rigid inspection, safe workmanship, practical ideas and cleanliness.

COLD MILL AND PICKLING EQUIPMENT MAINTENANCE

By K. T. BRADY, Assistant General Foreman, Great Lakes Steel Corp., Detroit, Mich.

Industrial requirements for cold rolled strip steel following the war years created a production problem without parallel in steel mill records. Expansion programs provided new buildings and new machinery, whereby these requirements could be filled by more and more production. Schedules had been stepped up so that provisions for maintenance time were reduced to a minimum.

In order to operate under schedules of this type,

close cooperation is necessary between production and maintenance supervision. This is accomplished by weekly production meetings with all cold mill general foremen and cold mill superintendents, where the needs of each particular department are discussed and a course of action determined.

Each supervisor presents his required work list for the week and any special attention which his units may require, either for production or safety. At this time the units which are to be shut down are determined, and the general arrangements are made as to the date and time.

All planned shutdowns are determined by the relative need for the maintenance in question, whether production, repaid, or preventative. All factors are considered, and that particular unit is shut down for eight hours or longer, as the work may require.

The number of pickler, tandem mill, and processing units makes it necessary to stagger all shutdowns so that the maintenance department can do justice to the units down. This also holds the maintenance force in balance with the work at hand. Otherwise, the number of men required for complete department shutdown repairs would be excessive.

However, the operating units must have maintenance service also, and it is necessary to cover this service with a skeleton crew. The balance of the crew is placed on the down unit. This flexible method of working is obtained by having the number of established job positions held to a minimum, thus permitting the balance of the crew to be moved to meet with any emergency which may arise.

Mechanical maintenance in a cold mill can be divided into three sections: consisting of production, preventative, and general repair. Production maintenance includes all work where parts are changed due to wear caused by direct processing of steel. These parts consist of welder dies, shear knives, pinch rolls, stitcher punches, leveler rolls, breaker rolls, mill back-up rolls, tension reel blocks, etc.

Preventative maintenance includes all work involved in checking and replacing parts before failure occurs. General repair includes the rebuilding of all spare machines and parts such as levelers, gear drives, tension reel blocks, small shaft assemblies, mill spindles, annealing furnaces, and bases, and general maintenance of miscellaneous equipment.

Of these three sections, the production maintenance takes priority and has to be done to maintain flow of material and quality of product. The other two sections are worked in relation to the first, so as to enable the whole to be done with available overhead crane service.

The logical time for overhead crane repair is during the period of reduced production, when these unit shutdowns occur. It then becomes a problem for production supervision and maintenance supervision to expedite the crane service without causing delay to the operating units. This is not as difficult on the larger units, such as tandems and skin mills, which are located well apart, but the continuous picklers, due to the length of the units plus the need for scrap disposal and coil supply, require practically continuous crane service.

These difficulties, which would not exist under normal production schedules, have to be met by solid cooperation and decision by all supervision concerned.

To eliminate the volume of work at any one shutdown period, the maintenance department must find ways and means of extending the time intervals between repair or rebuild of machinery in these units so shutdown periods for this purpose can be kept to a minimum. This permits the preventative maintenance and small repair to be accomplished during the period when the unit is down for principal production maintenance.

This could only be done by increasing the wear and shock capacities of the machinery now operating at the higher speeds of modern pickling and cold roll equipment.

In order to do this it was necessary to probe and analyze the causes of all breakdowns and short term service of parts which were causing too frequent repairs or replacement.

It was found in most cases that something had to be done with the metallurgy of the component parts at fault.

In general this has been developed by two methods. One by trial, using experience as a base for decision, and second, placing the problem with the metallurgical department for study and analysis, then proceeding on their recommendations. Normally, if the problem involved frictional wear, it was developed by trial, but if failure was caused by shock, load, or in combination with friction wear, it was turned over to the metallurgical department.

It was necessary, in some cases, to make changes in the design of the machine or parts, although in general, the parts could be ordered in tougher or hardened material.

Applying this to the problems on the various machines, which were responsible for the most downtime, gave the following results:

Chain idler sprockets with bronze bushings on the continuous pickler entry coil downenders were giving considerable trouble by seizing up and breaking chains, or excessive wear caused slack chains to jump sprockets. This was due to the inability of bronze bushings to hold lubrication for a long enough period and take the applied load. It was reasoned that a roller bearing, running on a hardened steel shaft, would provide a lubricant reservoir and develop the anti-friction qualities needed. The effect of this change was immediate and no further trouble was encountered with these machines in this respect.

The coil processors, which were designed for much lighter coils and slower speeds than the present pickler permits, were not able to hold up under the new conditions. The scale around these machines created high abrasive conditions which wore out the original surfaces rapidly. To replace these constituted a major rebuild and takes considerably more time than the average shutdown period, so again better material was required.

The mandrel gibs and heads were redesigned to take hard bronze and hardened steel liners. Breaker rolls and pulling roll head frames in vertical guides were provided with hard steel liners instead of brass. These

changes gave from six to eight months increased service.

The mandrels were changed to tool steel and after the first year of operation showed little wear compared to the original which had to be welded to size every six months.

Overloading roll drive gears in coil turnover gear case caused gears to open and split at the keyways. Heat treatment of gear corrected this fault and there have been no failures after proper treatment was found.

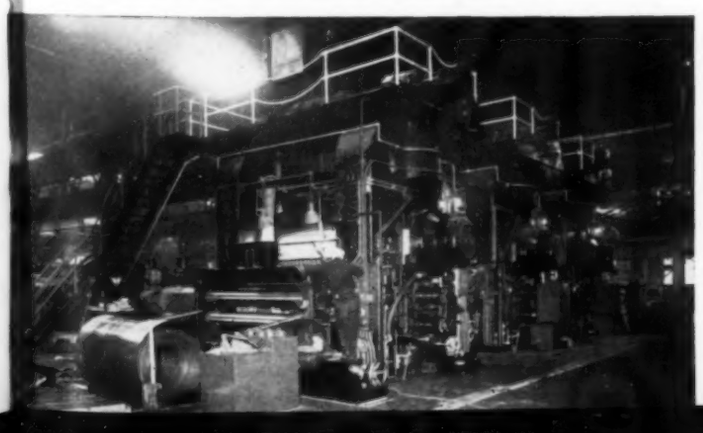
These savings in time have permitted more production maintenance to be applied to these machines to keep guides and rolls in condition to properly handle the coils.

Installation of new upcoilers on the delivery end of the continuous picklers allowed the size of coils to be increased. This meant that more welds would be made at the flash welders with the resultant increase in wear. These machines having bronze-bushed links and steel pins, and high scale conditions, coupled with movement through small degrees of arc, and high pressure, resulted in upset bushings, and galled pins. The crank pins had been revised several years before to take hardened steel sleeves and it became no longer necessary to dismantle this machine to replace the cranks, with the resulting loss of production time. So it was decided to carry this still further, and the shop and metallurgical department provided new, hardened steel pins designed for strength and wear resistance. These pins, varying in diameter from 4 in. to 7 in., operate in hard centrifugal cast bronze bushings. These have operated for nine months, and have given at least six months better service to date. The removal of pins has been less difficult, and no evidence of galling could be found on inspection.

Tandem mill production is greatly increased by large coils which are made up of smaller coils welded into one continuous strip, with each weld trimmed to the strip surface. Now even a good weld can be nullified by a poor trim, and if the trims are bad in a coil, the tandem mill has to be slowed down with consequent loss of production. Experience with flash trimmer knives using welded hard inserts on mild steel bodies warping during the grinding operation, caused a change to solid tool steel knife. Where knife changes would run into many hours before, due to knives sticking in the ways of the machine, they now can be changed in forty minutes to two hours depending on whether the knives are turned or new set installed.

The advantages to production were better trims and more rapid knife changes when required, while for maintenance, the more frequent changing kept the knives in better condition by reducing spalling and edge failure, thus requiring less material to be ground off to return the cutting edge.

Figure 1 — This 93 in., 3-stand tandem cold mill at Great Lakes has a maximum finishing speed of 1600 fpm. It was put in operation in December, 1947.



The tonnage on welder dies has been increased by the use of berylium-copper inserts on both working surfaces of the dies. This permits the use of the body of the die as long as there are no physical defects or deformation. These dies are sent out for new inserts when they reach ½ in. to ¾ in. of the original height. The inserts give better resistance to edge burn-off and pitting; also resist abrasive wear due to the moving strip. This type of wear is the common cause for welder die changes. The physical properties of the inserts have been changed in the last six months by changing from cast material to a rolled material, thus giving a lower brinell reading and denser structure. The cast material was too hard and occasionally split in service.

The use of hardened steel roller side guides has been standardized throughout the whole mill and even used on pickler tank guides where high corrosive conditions would make it questionable. These tank guide rollers run on monel metal pins with oilless bronze bushings and thrust washers supported by acid resisting bronze heads. At present the rollers are made of cast hard material and ground to shape.

The length of service for this type of guide has been more than four times the life of the old style acid resisting bronze discs, and they can be changed in place very easily.

It may be interesting to note here that the submerged arc process of automatic welding which is widely used at our plant has been the means of providing hard steel pinch rolls when delivery dates for new rolls were in the ten and twelve month stage.

Normally, rolls which have been ground below their hard depth, were sent out for heat treatment at very high cost, and a continuing loss of diameter by further grinding. By welding these rolls back to original diameter, it was possible to keep ahead of long delivery dates, and continual changing of pinch rolls due to loss of crown.

It was also possible to salvage rolls which were formerly scrapped, by building up to approximately ⅜ in. of diameter with soft steel rod, then finishing with hard steel rod.

Experience with this type of roll welding, developed a technique so that the last pass of hard rod would give a Rockwell reading high enough to give the roll the wearing qualities of a new roll.

This is accomplished by pre-heating roll and welding to ⅜ in. under diameter, then the next ¼ in. with hard rod. The roll is then allowed to set until dead cold. The last pass is then applied rapidly, and the resulting fast-cooling gives the hardness required.

This technique has been applied to processor pulling rolls, trimmer pinch rolls, and is especially valuable when rolls are needed in ratio diameters to correspond to gear train ratios as used in five roll straightener combined with pinch rollers. It has also been used extensively to rebuild scored roll necks where bearings run directly on neck.

Further assistance from the metallurgical department has developed screwdown worm-wheel hub bolts

on tandem mill screwdowns. The first set of these bolts was placed in these cone-type worm and worm-wheel installations over two years ago, and is still in service. Replacing these bolts with the treated bolts has reduced breakdowns to a minimum and frequent inspection forewarns in most cases, so that the change can be planned.

Metallurgical aid was sought in the design of set-up arm pins for flying shears, and also for set-up idle gears. Frequent breakage was eliminated by the change of heat treatment of these parts.

The successful solving of the stated examples, by applying the outlined methods of trial and metallurgical recommendations, has very definitely improved the present capacity for operating under heavy production schedules. It is believed that by continued application of this procedure as new problems become evident, a period of peak production can be withstood with less downtime needed for general repair or rebuild.

However, it should be mentioned here that maintenance of machinery and the operation of producing units does not complete the record. The thoughts of the nation have been directed towards the appalling number of industrial accidents which have occurred in all industry.

This problem, too, must be solved by the consistent use of safety and human engineering, before peak production can be attained. This has been proved in the first three months of this year in our plant, where a long range, well-planned, safety program, administered by safety-conscious supervision has resulted in high production schedules completed in the safe manner.

BOILER MAINTENANCE — FEED WATER TREATMENT

By L. F. COLLINS, The Detroit Edison Co., Detroit, Mich.

Water constitutes the prime essential of industrial life. In defense of this proposition are the large amounts used in processes such as sugar manufacture, wherein 10 tons of water are required to produce one ton of finished product, steel production, where the ratio is 65 to one, and synthetic rubber, where the ratio of 1200 to one persists.

So long as trouble-free operation is obtained, there are virtually no considerations related to water engineering that will fire the imagination of a process engineer. With a period of recurrent troubles, however, the same brain sometimes generates postulates that overlook most of the basic considerations.

Virtually all of the industrial ills originated by water are generated by the impurities carried by the water, not by the water itself. And, from an industrial use standpoint, all waters are impure. In virtually all industries the water used for process purposes is so vigorously mauled that it would seem prudent to consider briefly the sequence of tortures to which it is subjected.

It is picked up by a churn—the centrifugal pump. Therein it is belted about unmercifully. In a frantic effort to escape, it dives down an iron corridor, the discharge line, but presently discovers that the escape hatches lead only to fever therapy boxes, i.e., various types of heat exchangers. In these it is pushed back and forth through countless narrow alleys that grow hotter and hotter. Finally, when Old Man River has about reached the boiling point, he is dumped into limbo, the modern steam boiler. Therein he is "driven crazy with the heat." (Steam has been defined, facetiously of course, as "water driven crazy with the heat.")

Perhaps some may feel that such flights of the imagination, as the one in which we have just indulged, have no proper place in an engineering discussion. If such be the case we should like to explain that our lack of decorum springs from our inability to devise a better word picture of the fact that agitation and heating are the physcial forces that most often stimulate water to originate industrial ills. Without such stimulation, troubles are unlikely to occur.

All the waters impounded by reservoirs are contaminated by gases, solids, and biochemical organisms. Oxygen and other deleterious gases dissolved in water impart to such solutions an appetite for the common metals and minerals such as limestone and gypsum.

In attempting to satisfy this appetite, metals are eaten up, i.e., corroded, and minerals are put into solution. The minerals, so dissolved may be forced out of solution when the water is agitated or heated, thus forming scales, and they may also suffice, in part, as food for biochemical organisms.

Oxygen and carbon dioxide are the gases most frequently causative of corrosion troubles. While the rate of attack, by either gas, is proportional to the amount dissolved in the contacting water, so many other relevant factors are also influential that a chemical analysis alone seldom suffices as a basis for predicting corrosion troubles. For this reason direct measurements of corrosion, by means of the simple device, shown in Figure 1, are becoming more and more recognized as the more logical approach to such problems. By means of this device, one can determine in a period of 30 days or less the rate at which any selected metal will be attacked by the contacting medium under actual operating conditions.

In the process industries, failures due to corrosion, rarely cause important financial losses unless they compel unscheduled outage of major equipment. More often the cost of corrosion is represented by the manhours required to remove prohibitive accumulations of corrosion products. In power plants, deaerating feedwater heaters of the tray type require such periodic cleanings. Experience attests that the manhours required for such work can be approximated by the equation

$$M_h = 0.05\ W$$

Where W = Total pounds of oxygen that have entered the unit since the preceding cleaning.

For condensate systems that operate almost continually under positive pressures, experience indicates that the maintenance made necessary by CO_2 corrosion can be approximated by means of the equation

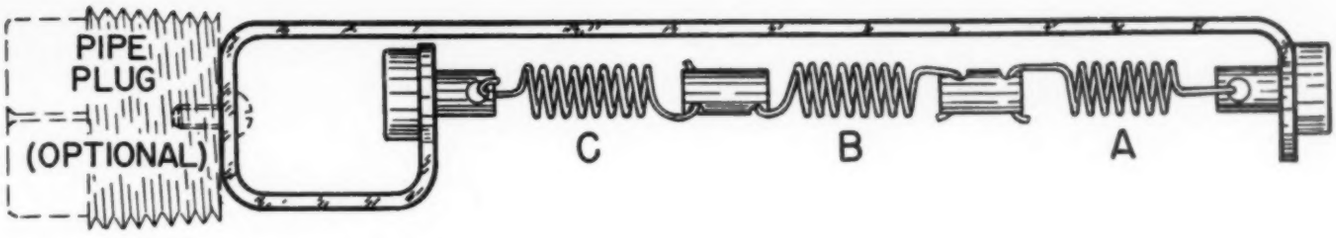


Figure 1 — This corrosion tester will predict behavior under operating conditions.

$$M_h = 12.5 \sqrt{W}$$

Where M_h = Manhours required annually
W = Total pounds of CO_2 entering the system in one year.

In the field of municipal water supplies, it has been estimated [1]* that the "extra" pumping costs, resulting from roughing of the inner surface by corrosive attack, amounts to about 10 per cent of the gross revenue of the average water utility. Presumably, a like cost holds true in industrial uses.

The rate at which scales form is determined primarily by the rate of heat transfer across the surface which separates the heating medium from the solution being heated, and the solubility characteristics of the materials dissolved in the contacting solution. Thus, any material that is less soluble in hot water than in cold is a potential scale former in heat transfer equipment.

Limestone, which when dissolved in water, imparts to the solution a characteristic called "carbonate hardness," and gypsum, which contributes "permanent hardness," are both less soluble in hot than in cold water. Thus, most scales contain high percentages of these minerals.

Tests conducted in England [2] on steam locomotives showed that the maintenance labor required to descale such equipment could be predicted by means of the equation:

$$M_h = 0.04\,T + 0.2\,P$$

Where M_h = Manhours per cleaning
T = Total pounds of carbonate hardness in entering water
P = Total pounds of permanent hardness in the entering water

It is the writer's experience that this equation holds equally well for small stationary plants. The high cost of scale in steam boilers, however, comes not from the cost of cleaning or fuel losses, but rather from the higher investment in boiler capacity which must be provided to compensate for the low steaming rates that must be utilized when scale forming waters are used.

Virtually all natural water supplies are innoculated with slime forming organisms. Even so, their presence is not proof positive that prohibitive amounts of slime will form. If conditions favorable to their incubation persists, these organisms multiply at an incredible rate. A statistically minded bacteriologist once calculated that if the maximum observed rate of growth would persist, a single bacterium could fill the oceans with its progeny within a few days. [3]

Slimes may appear as anything from a rubbery like membrane to almost a scale deposit. They are poor heat conductors. Investigations in the electric utility field attest that the cost of "tolerable" amounts of slime in condensers is of the order of $50 to $70 per year per 1000 kw of capacity. [4]

Diagnosing troubles, such as those previously outlined and developing practical corrective measures constitutes the art of water doctoring. Applying this art effectively is, obviously, a phase of plant maintenance.

Because water supplies never exhibit the exact same characteristics, and because industrial uses seldom present the same demands, no schemes of water conditioning have yet been developed that have general applicability. Invariably they must be tailored to meet the peculiarities of the plant in question. In such a development, however, the following criteria are employed:

Corrosion prevention—Since corrosion, for the most part, is due to the action of deleterious gases, any corrective measure must have as its objective, either degasification of the water, production of an impervious barrier over the surface of the metal, or use of a material that is immune to attack.

Degasification can be accomplished mechanically, with either hot or cold water, by means of deaerators, or chemically by adding reactive materials that will "fix" the gas. For the latter purpose, sodium sulphite is used to sequester oxygen, and alkalies to neutralize CO_2.

The chromates are most often used to develop protective films on metal surfaces. Less often, sodium silicate and phosphate salts are employed.

The alloys of copper, and the stainless steels are most often employed when corrosion resistant metals are required.

Scale prevention—In the prevention of scales one of three expedients is usually employed:

1. Chemicals are added to the water to delay precipitation of scale forming materials until the water has left the process equipment.
2. Chemicals are added that will cause the scale forming materials to precipitate as a sludge rather than an adherent material.
3. The scale forming materials are removed, i.e., the water is softened.

In selecting the chemicals and equipment mandatory to such treatments, considerable experience in water engineering is of the essence. Most of the failures identified with water treating schemes in this category can be traced to inexperience in making such selections. [5]

Slime prevention—In most cases adequate steriliza-

*Numbers refer to Bibliography at end of article.

tion can be obtained by the introduction of relatively small amounts of chlorine into the water. Occasionally chlorination alone will not suffice and supplementary bactericides must be employed.

The foregoing brief review has attempted to point out the following basic facts:

1. That it is the contaminants carried by the water not the water itself that generates virtually all of the troubles attendant upon the use of water for industrial purposes.
2. That insofar as industrial uses are concerned, all waters are contaminated.
3. That such troubles can be avoided by adequate water doctoring.
4. That effective water doctoring is a phase of plant maintenance.

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THE METALLURGY OF STEEL PLANT MAINTENANCE

By R. E. CRASSWELLER, Research Metallurgist, Great Lakes Steel Corp., Detroit, Mich.

▲ IN this paper an attempt will be made to show some of the advantages which may be achieved through metallurgical considerations and assistance in steel plant and mill maintenance.

So far this year our industry has operated at 100 per cent of capacity. Throughout the years, normal operating rates approximate 70 per cent of capacity. Weekend shutdowns are consequently shorter now than formerly. Production is needed as never before and breakdowns are frowned on in like manner. All told, the maintenance departments throughout the industry need all the help which is available.

The metallurgy in steel plant maintenance is the selection of the best type of metal for the application under consideration and the proper treatment of that material so that the part will be able to withstand the intended service. The better the performance of parts in production line or mill service the less the number of replacements, thus reducing the number of downtimes and giving a longer production time. It might be well to mention that we have frequently observed that a heat-treated part in failure is less apt to be bent or battered from service and, as a consequence, is more easily replaced. This results in shorter downtimes.

REQUIREMENTS OF THE PART

Let us consider a few of the requirements of a heat-treated steel, whether alloy or plain carbon. Sometimes failures are caused by faulty design. Some parts made from heat-treated alloy steel may fail because of too sharp a junction, such as will be found on the neck of a roll. By designing a substantial fillet of metal at a location of this type, failure of the part can be eliminated or greatly reduced through the absorption of some of the loading by this added volume of metal. Shortly after the end of the last war, trouble was encountered at the continuous pickler in that the punches used in stitching the bands of NAX high tensile steel, prior to pickling, were failing so fast that it was necessary to replace broken punches every day. Study of several broken punches showed that by the use of an alloy steel, affording greater depth of hardness, and a change in design, going from a sharp fillet to a tapered or filled-in fillet, the service life of the punch was increased from one or two days to two to three months.

Sharp tool or grind marks should also be avoided as they contribute to high stress concentrations in the same way as do sharp fillets. Unexplainable failures should be analyzed carefully with regard to these stress raisers.

Because of increased service demands, it is frequently necessary to increase the size of a part if made from the regular material. The use of alloy steels or heat treatment, or a combination of both, can result in greater strength with substantial reductions in size.

In looking for higher strength, a treatment of quenching from a temperature around 1600 F and a drawing at a low temperature will impart even a slight increase in the strength of a low carbon steel over the same steel in the as-rolled condition. Such material, however, is not as desirable as higher carbon or alloy steels which are capable of being heat-treated to higher strengths.

One thing we find that always goes hand in hand with moving parts is wear. There are numerous ways of minimizing this wearing away of moving parts. Lubricants, coolants, bearings, etc., all are employed in their proper place to lessen wear. From a metallurgical standpoint we are concerned mainly in preserving the original dimensions of a part through the use of heat treatment which usually results in increased surface hardness.

If the part has repeated loadings and unloadings and there is any tendency to flex or bend during the loadings, a problem of fatigue is encountered. Failure can result at loads lower than the strength of material if there are enough repeated loadings. To remedy this condition, higher strength through heat treatment is the first alternative. Redesign of the part to reduce high stress concentration, which may exist due to sharp fillets or rapid change in section size, is sometimes the only remedy. Experience in the automotive and rail-

road field has shown that shot peening of the surface is one of the most effective ways of increasing fatigue life.

SELECTION OF MATERIAL AND HEAT TREATMENT

When the facts are in, a decision can be made regarding the material which is required for the part. Our experience has been restricted mostly to steel, so discussion will therefore center around this material.

Often, on checking a blueprint or the specification of some piece of equipment, you will find that any reference to the composition or mechanical requirements of some part is simply stated "to be hard or harden." How hard? What steel should be used to get this hardness? Is the hardness to be in a 250 to 300 brinell range or 400 to 500 range? A careful study of the equipment, the performance or job the piece of equipment is to do, and what phase of the job the part is going to uphold will help to answer the above questions. The use of an alloy steel can lead to a quick and easy answer, in that various degrees of hardness can be attained with greater accuracy, and a trial and error practice will determine the hardness most suitable for the part.

This brings us face to face with one of the biggest problems of maintenance, that of knowing the composition of the material being used to make the part. In view of the recent shortages in various steels, the tendency has been to make the size of the stock fit the application regardless of the type of steel. This practice frequently results in not obtaining the optimum properties from heat treatment. In general, the larger the part or the higher the hardness desired, the higher will the carbon content and alloy have to be. Such elements as chromium, manganese, molybdenum, and nickel increase the depth to which a part can be hardened; carbon determines the level of hardness obtainable. With the proper carbon and alloy content it is then possible to obtain the hardness, strength, or toughness desired through the selection of proper heat treating cycles.

From the above, the desirability of stock piling steels of known analyses in various sizes is readily apparent. Two or three types of alloy steels will provide a range of heat treated hardnesses in practically all sizes. By careful study of the size stock most used in making parts and replacement equipment, those sizes covering the majority of the parts can be placed in a bank. Proper identification of each bar will save needless reanalyzing prior to heat treatment, as a knowledge of the chemistry of the steel is important to the heat treater. A carbon-chrome steel of 0.50 per cent carbon and 1.00 per cent chromium could take care of applications of large size parts or high hardness requirements, while a medium carbon alloy steel similar to AISI 8630, would fit the smaller ones.

ACCOMPLISHMENTS

I would like to take a little time to give a few examples of the metallurgical aid that has been employed at Great Lakes Steel in plant maintenance.

One of the best returns in lowered replacements has been obtained through the use of heat treated coupling pins in the 36-in. hot strip mill, the 96-in. hot strip mill, and in the cold mill. Considering the 96-in. mill, there is a 3½ in. diameter roller pin and a 3 in. diameter straight pin in each coupling connection between work roll and motor. Each pin is approximately 13 in. in length with the roller pin having a 2½ in. shoulder at each end. Normally, a year's replacement for untreated pins was from 90 to 100, but now that replacement is made with a heat treated pin, the machine shop has cut the quantity in half. At the same time there has been a reduction in downtime on the mill. The untreated pins when overloaded bend and, on occasion, the loss in production has been a matter of hours instead of minutes as it was necessary to burn the pins out with an acetylene torch. The treated pin withstands the overload or fails abruptly, and no serious damage is encountered. Replacement of the pin is accomplished in a short time.

About a year ago a ladle containing nearly 250 tons of molten steel was being moved in the open hearth. The four bolts in a plate that held an end of the shaft of the hoisting drum on the crane broke. Fortunately, by careful manipulation, no harm resulted. When the broken bolts, measuring 1 in. in diam by 13 in. in length, were examined they were found to be of SAE 1020 steel. The hardness was 66 Rockwell B, equivalent to about 65,000 psi tensile strength. The micro-structure was typical of as-rolled steel, a ferrite and pearlite pattern. Bolts for all the cranes in the open hearth were made up of NAX X-9130 alloy steel and heat treated to a Rockwell C of $^{35}/_{37}$, equivalent to about 160,000 psi tensile strength. All the weaker bolts were replaced.

Another example of the advantage of heat-treated alloy steel came about in the use of a heat-treated carbon-chrome bolt over a normalized straight-carbon bolt in the screwdown assembly of the tandem mill located in our cold mill department. In the assembly there are 18 bolts, 1⅝ in. in diameter by 12 in. in length, that hold a ring gear in place and, on occasion, the heads or the nut end snap off from overloading, resulting in a loss in production time of from 4 to 6 hours. At the present time, and to my knowledge a set of heat-treated 0.50 carbon, 1.20 chrome bolts that were used to make up one of these assemblies has been in operation for over 2 years. Other assemblies made up with untreated bolts have failed during the time.

We have heat treated lathe centers that gave increased service life over the untreated. Several centers made from carbon-chrome and NAX X-9145 alloy steels, after heat treatment, outlasted carbide-tipped centers when being used during the machining of brass.

These are just the few of the applications that have been studied and improved upon. Gears, liner plates, coiler pins, guide rollers, dowels, bending pins, steel bushings, vise jaws, and guide bars are some of the other parts that have been improved upon in regard to service life.

In conclusion, it is believed that knowledge of the requirements of the part, proper and studied selection of material, application of the material in its most desirable condition, and supervised study of service life together, comprise a successful and worthwhile program of metallurgical aid in steel plant maintenance.

Symposium

ON STEEL PLANT MAINTENANCE PRACTICES

at the Ford Motor Company

. . . . increased production can be obtained through better maintenance without effecting changes in the equipment itself . . . .

Open Hearth Maintenance

By C. W. CONN

Superintendent, Open Hearth Steel Division

Ford Motor Co.

▲ IN the open hearth we have maintenance problems on mechanical and electrical equipment, but our greatest headache is the maintenance of furnace brickwork. The country is in need of more steel and every operator is attempting to produce more. Various methods of increasing production are being used and some companies are enlarging their steel making capacity. This takes time and it will be some time before we see results. I mention this to show how aware the industry is of the demand for steel, and how, by better maintenance we are trying to utilize to greater advantage the facilities we now have. I am speaking of the industry as a whole, not just the Ford Motor Co. open hearth. The point that I want to make is that by greater or better maintenance we can produce more with what we already have.

The practice in years past was to squeeze out every heat possible, unless the roof fell in and settled the question. This practice usually caused loss of tonnage by increasing the extent of repairs and the rebuilding time. By establishing a definite program of furnace repairs, and strict adherence to a rebuild schedule; that takes the furnace off the line on the predetermined day, even though it could be run for two or three weeks longer, it has been possible to keep more furnaces in constant production. In our shop at Ford's we have ten furnaces, and we strive to keep nine in production, with only one down for repairs at any time. This means we sometimes sacrifice bricklife in taking down a furnace, but when two furnaces are down at one time, our mason department can only cover one at a time, and suffer loss of production by the longer downtime on the furnaces being rebuilt.

Great improvement has been made toward shortening the downtime on furnace rebuilds. Only a few years ago if a furnace operated 90 per cent of the time and was down 10 per cent for brickwork, it was considered pretty good. Now the industry average is 7 per cent downtime for brick repairs and some shops are talking about only 5 per cent. A year has 365 days, and allowing 10 per cent downtime for brickwork, it means the furnace is off the line 36½ days a year—to cut this in half as these people who say that they have only 5 per cent downtime is quite an accomplishment.. A 200-ton furnace making two heats a day would produce approximately 7200 tons more steel in those 18½ days that they wish to shorten this normal downtime. Another thing that I would like to point out, if this can be done on every furnace in the shop in a shop like ours that has ten furnaces, it means a total of 72,000 tons in a year's time that can be picked up just by cutting the downtime or the brick maintenance time in half. Some of the factors that have helped to accomplish this are, use of explosives to break up slag, machinery of various kinds to speed up removal of slag, vacuum conveying system to remove dirt from beneath checkers and flues of furnaces, fork-type industrial lift trucks for handling bricks on pallets, belt conveyors for unloading bulk material from railroad cars to bins, and checker cleaning machines.

Presented before AISE Detroit District Section Meeting, October 14, 1947.

Our second major problem of maintenance is that of bottoms. Every basic bottom is refractory to the extent that it contains periclase (MgO) and high temperature refractory bonds such as calcium orthosilicate. Every bottom is progressively contaminated by impurities. Slag, iron, dolomite and lime penetrate the bottom, are absorbed and replace the original refractory properties. In fact after a few years service, practically the only refractoriness in the working surface is that introduced in normal fettling after each tap. The refractory problem of the basic open hearth bottom is not by any means entirely a question of the materials used, but is also a question of how those materials are applied. Hearth refractories at present are superior to any heretofore available.

The responsibility of maintaining a good bottom lies primarily with the first helpers and melters. Any holes, any low or sloppy spots should never be passed up with the thought that they are not critical.

With bottom maintenance, as with brickwork maintenance, great progress has been made. Very seldom do we hear of a furnace being down for bad bottom for twelve to twenty-four hours as was the case in years gone by. We clean out the holes fast, fill them fast and then do not spend unnecessary time burning in the refractory material. There is a great stake and increased tonnage in fast bottom repairs, just as there is in fast brickwork repairs.

In this short talk on maintenance in the open hearth, the point that I want to stress is the fact that by better maintenance—I think too often when we think about open hearth maintenance, we are thinking about the electrical and mechanical equipment. Now, although this is of great importance, brick maintenance and bottom maintenance, in our own shop today, is of prime importance because there is a lot of tonnage to be picked up by cutting the downtime for brick repairs and cutting out unnecessary bottom and bank delays.

DISCUSSION

PRESENTED BY

LEO M. CUMMINGS, Meter Foreman, Great Lakes Steel Corp., Ecorse, Mich.

F. W. SUNDBLAD, Assistant Supt. Open Hearth, Great Lakes Steel Corp., Detroit, Mich.

W. J. REILLY, Assistant Manager of Steel Operations, River Rouge Plant, Ford Motor Co., Dearborn, Mich.

H. F. LESSO, Open Hearth Control Metallurgist, Great Lakes Steel Corp., Ecorse, Mich.

C. W. CONN, Superintendent Open Hearth Steel Div., Ford Motor Co., Dearborn, Mich.

Leo M. Cummings: I do not know just how much our problems vary from other open hearths, however, we do have them. I am wondering to what extent this taking furnaces off on some prearranged schedule is working out. How far in advance could you arrange a schedule? Has that been tried successfully?

C. W. Conn: The truth is that we have not been at it long enough to give a fair answer to that question. What we are striving to put into effect now, and in the future, is a plan. You have to plan, otherwise you end up with two or three furnaces down at the same time, and the prime or the most important reason behind that decision is labor. We have a very limited number of brick masons, and we can only repair one furnace at a time. Having ten furnaces, if we can successfully control this and only have one down at a time, we will have accomplished something, and that is the purpose of this planning. I do not know that I am answering your question, the fact is I cannot answer it because we have not had it in effect long enough. It has been done successfully, I think, at a lot of places.

F. W. Sundblad: I would like to know a little more specifically about the checker cleaning equipment that you mentioned.

C. W. Conn: In that regard I am thinking of things such as soot blowers beneath the checker itself that you can open during the run of the furnace, and move the soot, to keep it from piling up directly below the checker. With our present setup it is a hot, slow, tedious job to clean out the flues. Some plants in recent years have raised the arch so you can go in there and do a fairly fast job. Ours are low and have not been changed in that regard, and you have to go down there on your hands and knees and rake it back, so it is a slow job, and we definitely have lost time putting furnaces back on by not having made some provision to remove the flue dust from beneath the checkers faster.

I have had some experience with the steam jets installed in the brickwork beneath the checkers, and we are moving that way. I am thinking about one job this summer that we lost 48 hours on, cleaning the flues after the furnace brickwork was finished, and it was ready to light up. We had not planned right, and the distribution of labor was evidently wrong and we came up with all the brickwork finished, yet we still had the cleaning job to do. I think such things as the soot sucking machine, a vacuum system of some kind, and also the steam jets to move it from the back of the tunnel to the front where it is easier to get at, that we can accomplish a lot and save a lot of time.

W. J. Reilly: I might add in regard to soot blowers that I had some experience with them and they were very successful. We had furnaces that averaged in the neighborhood of 270 heats on the roof, and when we took the furnace off we had considerable dust in the flues. The blowers worked very successfully. On a number of occasions all we had was a couple of wheelbarrows of dust to take out when we took the furnace off. We would blow them about once every week and we always made a practice, of course, of blowing them on the last heat, or next to the last heat when the furnace was going down.

H. F. Lesso: It is generally believed that the character of the deposit found in in the slag pockets and regenerative system of an open hearth furnace is largely related to the character of the raw materials. In view of the present trend in the raw material problem, what attention should be given to the examination and evaluation of the raw materials charged into the basic open hearth furnace.

C. W. Conn: There should be a lot of thought given to it. I think that is particularly true where the deposit

on top of the checker gives trouble. Ours is a soft dirt and is easily removed. We are moving towards a high metal charge all flush heats, because of poor scrap, no scrap, and the fact that the company intends to build another blast furnace. Whether that will add to our problem, and it probably will, we do not have any choice in the matter. But at the present time we are not troubled with the deposit on top, the thing that bothers us is down in the flues—it does pile up down there to a considerable degree. With the use of the blowers I think we can solve the problem.

H. F. Lesso: Do you believe some preliminary processing of raw materials would be helpful?

C. W. Conn: Definitely, yes on ores.

Fuel Economy Through Maintenance

By B. D. BARNES

Fuel Engineer

Ford Motor Co.

▲ MAINTENANCE of fuel-burning equipment has a considerable influence on the efficiency of the combustion taking place within an open hearth furnace. This is true primarily because we are dealing with high temperatures, and depend largely upon a radiation flame.

The intensity of a radiation flame is governed by a number of factors, namely:

1. The temperature of the incoming air.
2. The degree of moisture within that air.
3. The rate at which the air comes in contact with the oil particles.
4. The temperature of the incoming fuel.
5. The moisture content of the fuel.
6. The amount and temperature of the steam necessary to atomize the oil.
7. The degree of free flow of the flame travel.

The air temperature is affected largely by leakage through the brickwork. Although air leakage from all points into the incoming air affects the flame efficiency, those leaks in the fantail and uptakes undoubtedly have the most damaging effect. This is because the highest temperature differential occurs at these points.

Consider a furnace using 12,000 cfm air and a 5 per cent leak occurs in the uptake. The furnace temperature is in the range of 2,950 F. The outside air temperature we will assume as 90 F and the specific heat as 0.24. The loss in Btu available to the flame would be 0.24 (2,950 - 90) x 45.8, the weight of 600 cu ft of air at 60 F, which we will assume is the air temperature through the meter, whose standard temperature is also 60 F. This loss would be 31,500 Btu. Assuming that the furnace is consuming 8 gallons of 150,000 Btu fuel oil per minute, the loss of available heat at the burner amounts to approximately 2.6 per cent.

The degree of moisture within atmospheric air is governed by nature and any correction would be economically impractical. Moisture which results from damper leaks and seapage should be eliminated.

To illustrate the damaging effects, consider a one gallon leak from a damper into the incoming air stream. Assume that the water temperature is 70 F and that the water is converted to steam at the furnace temperature, 2,950 F. The mean specific heat of steam in this high temperature range we will consider to be 0.5. This quantity multiplied by the degree superheat, (2,950-212), which represents the furnace temperature minus the boiling temperature of water at atmospheric pressure, all multiplied by the weight of water per gallon, 8.33, gives the heat of superheat. To this quantity must be added the heat of the liquid and the latent heat. The total quantity represents approximately 12,500 Btu which should have been available to the flame; a loss of about 1 per cent of the available heat.

The rate at which the air comes in contact with the oil particles is dependent upon the stream flow of the incoming air, and the degree to which the oil particles are atomized. Since the oxygen of the air must come in contact with the surface of the oil, the rate of burning takes place more rapidly when more oil surface is exposed, and when the air is directed close to the flame travel. A fine mist of oil naturally exposes more oil surface and is the ultimate in atomizing.

Should the atomizer become carbonized, a stream of oil may result which is not easily broken up. As a consequence the oil will enter the furnace in large globules and thereby decrease the surface area. The rate of burning is decreased and likewise the flame temperature.

We have found cases where a faulty nipple produced from 1.5 to 2 per cent combustible at the end of the furnace even though free oxygen appeared. One and one-half per cent combustible appearing in the waste gases while burning 8 gallons of fuel per minute, represents approximately 5.76 pounds of carbon per minute. Since the loss from not burning a pound of carbon completely from carbon monoxide to carbon dioxide amounts to 10,160 Btu, the loss in this case amounts to (5.76 x 10,160) or 58,500 Btu. This represents 4.87 per cent of the heat available to the flame.

The temperature of the incoming fuel has a direct bearing upon a radiation flame. Since temperature affects the viscosity of the oil, the degree and rate at which the oil may be broken up is likewise affected. For this reason the fuel line covering should be well maintained and the heaters periodically cleaned.

If considerable moisture is contained in the fuel, the flame temperature will be affected. Since the water enters at the temperature and pressure of the fuel, it must be first converted to steam and then be superheated to the furnace temperature. This naturally robs heat from the flame.

To illustrate the loss due to contained water, suppose the oil carried 1 per cent more water than it normally contains. This would amount to approximately 0.64 lb of water entering per minute. Figuring as with the entrained water in the air, except that in this case the water is under approximately 180 psi pressure and has already been heated to approximately 200 F by the oil heater, the loss will amount to 1,478 Btu or 0.1 per cent of the available heat.

Water of this nature results largely from seepage and settling within the storage tanks. The water within these tanks should be periodically drained.

Atomizing steam is only a necessary evil in an open hearth furnace. It is required for breaking up the oil particles, but robs heat from the flame. For this reason, should the line coverings be in a poor state of repair or the boiler superheater tubes be dirty, the steam may be in a wet condition. Such a condition would require that more steam be used to atomize the same amount of oil. As a result, since the total heat of the steam is lower and since a greater quantity is necessary, more heat must be taken from the flame.

As an illustration, consider that in normal operation 95 psi gage steam at 150 degree superheat is used to atomize, but the above mentioned conditions exist to such an extent that the steam enters the atomizer at 95 psi gage with 5 per cent moisture. Assume that in both cases the state of the steam leaving the burner is 10 per cent moisture. If a half pound of atomizing steam was normally required per lb of fuel fired, 122 lb of wet steam per minute would be required as compared with 32.3 lb of normal steam to atomize 8 gallons of fuel per minute. The extra 89.7 lb of steam must be first dried and then superheated to the existing furnace temperature, 2,950 F. The loss in heat would amount to 120,000 Btu or 10 per cent of the available heat.

The degree of free flow of the flame can have a decided effect upon the efficiency of the flame. If the burner is in such a state that it cannot be moved to clear a scrap obstruction, a loss will occur. This is because burned gases will have a tendency to become pocketed and interfere with the union of oxygen and the oncoming combustibles. A like state exists when too much pressure is applied to the furnace resulting from a leaking damper. This allows incoming air to recirculate back into the outgoing tunnel. A dirty boiler may also cause the same effect.

In the case of scrap interfering with the flow of the flame, we have found as high as 2 per cent combustible present in the gas analysis even though free oxygen was also present. When the scrap melted, this abnormality was cleared away.

The loss when calculated as in the case of a faulty nipple would amount to 76,000 Btu's or 6.4 per cent of the heat available.

Summarizing the losses by these assumed conditions:

		Btu	Per cent loss
1.	Incoming air temperature	31,500	2.6
2.	Moisture in the air	11,900	1.0
3.	Rate of oil air mixture	58,500	4.87
4.	Fuel temperature		
5.	Moisture in fuel	1,478	0.1
6.	Amount and temperature of steam	120,000	10.0
7.	Obstructed flame	76,600	6.4

The percentages of heat loss as indicated within this paper do not represent the overall efficiency of the furnace. It must be born in mind that part of the heat lost at the point of combustion will be reclaimed in the exhaust checker. These illustrations are merely presented to point out how and why poor maintenance can affect the heat generated by the flame.

Electrical Maintenance

By FRED GROVEN
Electrical Engineer
Ford Motor Co.

▲ I have choosen the subject of "Standardization of Electrical Equipment" and what it means in maintaining our production lines as well as safety to our men, and wish to tell about what we at Ford have done.

We have for years worked for the standardization of all electrical equipment. With this thought in mind we all worked together from the top man down and no idea was sidetracked without serious consideration. When the management of the Ford Motor Co. decided to change the plant over from d-c power to a-c, we were well aware at that time, which was about 1928, that there were a few manufacturers that made what they called a totally enclosed, fan-cooled motor. However, there were no combination motor starters, and by this I mean a starter and switch in the same cabinet with the switch handle interlocked with the door of same. The reason we wanted this was, we wished everything dead when the door was open. The same idea was carried out in all our master and distribution cabinets. Remember, the items I have just mentioned had to be invented by the various manufacturers and we were very grateful for the wonderful help given us.

Our management wanted a totally enclosed motor, but it had to be made in the same frame size as an open motor. We told the manufacturers what we thought should make a good motor without having them feel we were interfering with any of their engineering, especially as to what made it run. But we were very much interested in how long it would run, how much it would cost to keep it running, how safe it was made for our men to work around, and how well it looked. It also had to be dual voltage.

Some of you would have been surprised if you could have seen some of the motors offered to us at that time. Some were long, some short, some were fat and some lean, with all kinds of heat deflectors, etc. People laughed at our model "T" car, but our model "T" was a Lincoln in comparison to some motors that were offered for our approval. So it was necessary for us to make up a set of standards to guide manufacturers as to what we wanted and expected to get. It was the duty of every one concerned with the changeover to be on guard so we would not get equipment that was not safe in every respect.

We insisted on 110 volt control and starters had to be dust tight with a danger 440 volt sign on the door. The Ford Motor Co. wanted the very best equipment that was possible to make and was willing to pay twice as much for it to get the manufacturers of electrical equipment interested. You can imagine what a job it was for the manufacturers of electrical equipment to start making motors, starters, push buttons, limit switches, power cabinets, etc., to meet standards of safety.

Our most efficient safety department has had a hand in every change that was made and we had to abide by their decision. They were and are a group of men hard to fool when it comes to the question, "Are you sure it is safe."

I wish also to say a few words on maintenance of d-c motors with which steel mills and cranes are most commonly equipped. I have come to the conclusion that a d-c motor and a human being are in one sense very much alike. Take a human being, he may have a pain, a fever, or both at the same time. A d-c motor can have a bad commutator, poor brushes, a short or open coil in the armature or field with the same result. A man goes to the hospital to have whatever is wrong with him fixed. A motor is sent to the repair shop for the same purpose.

One difference between the two is illustrated as follows: Take the human being, he tells his boss he is sick or one of you superintendents might see him sitting down and will ask of him what is wrong. When he explains, you go to a lot of trouble to get him to the first aid or hospital as you should.

Now then, you will see motors sparking at the brushes day after day but not one out of ten will get after the motor doctor and let him know that motor is sick and needs attention. Remember this, if there is anything wrong with a d-c motor it will always tell you by its behavior. It will flash at brushes and have a fever and will die if not taken care of.

When I was a boy and we had sickness in our home our family doctor would call to see what was wrong and fix it at once, even to the cleansing of your system. He did not have an intern to do it. He would take off his coat, roll up his sleeves and go to work. Nowadays he will send you to the hospital. Why? So someone else can flush you out, give you a hot bath and a pretty nurse to give you a pill that you should have taken in the first place. Now all doctors do not do this, but there are a lot of them that do.

The same thing is taking place with our men that look after motors, etc. Instead of rolling up their sleeves and going to work they wait until the equipment is past the first aid stage and then send it to the repair shop. It is the easy way out of work and very expensive to the company.

I believe I have a cure for carelessness or indifference of maintenance men and superintendents. I would suggest you managers put a service board up in your office, the same as is put up for production, only this would show motor failures, etc., and reasons for them. Then, if they have a good showing, praise them. If not, let them share disgrace together. I am sure you will be surprised at the results.

May I ask you men in charge of various operations to help the maintenance men by reporting a hot or sparking motor or any other piece of electrical equipment that needs attention. Bear this in mind, whenever there is a sparking commutator or overheated motor you are sure to have a break down which in most cases can be avoided by everyone keeping their eyes open.

I would also like to say a word on the lubrication of ball bearing motors. I expect you men to be surprised to hear me say that there are more motor failures due to overgreasing and the wrong kind of grease than there are from the lack of same. Some thing has to be be done about this. We have contacted a company about making special fittings to be used exclusively for electric motors. This would be the only way of controlling grease used in motor bearings. It may be necessary to delegate one man to do motor greasing, as 90 per cent of motors need to be greased only once a year and the other 10 per cent every six months. This has become quite serious.

I am not able to estimate what your production loss would be in case of motor failure. But I have one place in mind where every minute means close to $1,000.00 and one rewind of an average crane motor would cost as much as two months wages for one man. So you can see how important it is that every one does his part.

DISCUSSION

PRESENTED BY

J. A. SHIMMIN, Plant Engineer, Operating Department, Rotary Electric Steel Co., Detroit, Mich.

FRED GROVEN, Electrical Engineer, Ford Motor Co., Dearborn, Mich.

F. C. HOSIMER, Wagner Electric Co., Detroit, Mich.

L. R. MILBURN,* Electrical Engineer, Great Lakes Steel Corp., Ecorse, Mich.

C. F. COWLEY, Lubrication Engineer, Sales Department, Fiske Brothers Refining Co., Detroit, Mich.

CLIFFORD DUNN, Sales Engineer, General Electric Co., Detroit, Mich.

WM. E. REIBER, Assistant Chief Electrician, Great Lakes Steel Corp., Ecorse, Mich.

J. C. WALKER, Ford Motor Co., Dearborn, Mich.

*Now Chief, Korean Power Mission, Seoul, Korea.

J. A. Shimmin: I wonder if you have any routine chronological replacement program for motors looking toward preventive maintenance?

Fred Groven: No, I do not believe so. I believe it would probably be a good thing if they would have, but we have a lot of spare d-c crane motors. I think a program directed along those lines would be a wonderful thing. Let a motor run so long, take it off, and put on another one. You have a good point there, and I think it should not be overlooked.

J. A. Shimmin: The standard motors and starters as presented by the manufacturers today, are they acceptable as far as your standards are concerned, or do you look forward to any radical changes?

Fred Groven: Yes. Now, as far as the standardization of motors, we did set up a standard, and we are sticking pretty close to it, sometimes the suppliers slip one by us, but we catch it after a while, you know, and somebody gets called down for it.

J. A. Shimmin: Have you had any experience with the new silicone insulation of mill motors?

Fred Groven: I did ask a company to see what they could do to make us a totally enclosed motor, not fan cooled but in the same frame size as a fan cooled. They endeavored to make us a motor, but it ran pretty hot—

it had silicone insulation. I do not imagine it is going to hurt the motor. I am putting it out on a production line but I would have to put it in a place where someone will not get their hands on it because the temperature rise is quite high.

J. A. Shimmin: What do you think will happen to the grease in your bearings?

Fred Groven: The same motor that I am speaking of, they tell me only has to be greased once in 5 years. I hope it is so. I think all of us could save a lot of money on grease if we would stick to the few rules these people lay down, every time a fellow walks down the aisle with a grease gun, it does not make any difference whether it is 600-W, or what it is, he has to give that motor a shot of grease until the end bell is just bursting!

F. C. Hosimer: I would like to say something here. I would like to add a little emphasis to the statement made by Mr. Groven on grease. I have had the occasion to see the results in our own shop where we repair a lot of these motors and I would say of the bearing failures that 60 to 75 per cent of failures are caused by over-greasing just as he has outlined. I have seen many cases where the windings of the motor were saturated with grease, which is certainly evidence of over-greasing.

L. R. Milburn: It is not so much failure due to over-greasing as it is to the waste of grease, not only on motors but on machinery. I have in mind several new installations in which we have the automatic greasing system on it and it seems everybody that goes by has to pump that handle. I have seen gobs of grease on the floor underneath the bearing, and that is not necessary.

C. F. Cowley: From my experience in the oil and grease business, I believe management can take a lesson from what has been discussed here tonight. When you get into the subject of lubrication, you will find in most plants the lowest man in the wage scale will be the oiler. The lubrication engineers, and other technical men discuss the fine points of lubrication, then make up a chart and expect the poorest paid man in the organization to apply the right product in the right place. Meanwhile they sit back in satisfaction hoping this will be done. It appears to me it is high time that industrial concerns elevated the oiling job, maybe glamorize it a little, and in turn have it pay off in big dividends through improved machinery maintenance.

I have been connected with the industrial lubrication business now for about 15 years on the selling side and 15 years prior to that in plant lubrication work, and I have found that it does not make any difference how big the plant is, they can all improve on that point. Elevate these men above the class of an oiler, call them what you may, but bring them into a semi-skilled class, and I am sure you will find men who would take an interest in such an occupation and save the company money.

Clifford Dunn: I wanted to say that in no industry, with the possible exception of the steel industry, do we get any more lessons on what equipment to manufacture than the automobile industry. If the manufacturers had listened to the automobile users of electrical equipment a good many years ago, we would have had the protective features we have today a good deal sooner because you people in the automotive industry give the equipment more severe service than any other industry I know of!

I might add one thing on this greasing problem, I ran across one d-c machine where we took the cover off of the commutator, and the entire commutator was completely incased in grease. Apparently the oiler had gone by it frequently and every time he went by he gave it a shot of grease. As a matter of fact, it was several years before we could persuade our people to put pressure gun type fittings on the motor just for that reason. When we did, of course, we very carefully wrote the instructions to take out the relief plug so you could not force grease in and have it come out along the shaft and end up on the winding, but lots of people, particularly oilers, do not read the instructions. I agree very heartily, we need better oilers.

Wm. E. Reiber: The gentleman spoke about spare equipment, do they have a program whereby they carry one spare for so many motors?

Fred Groven: Yes. We have a stock of spare motors, probably about 5,000, and out of that 5,000 there is about 500 to 600 that are in the repair shop. That is why I brought up this grease question because I imagine that every one here connected with motors in their plant are probably experiencing the same trouble that we are. When we changed over our plant, we adopted a system of brass tags for the motors, with the thought that every six months the fellow that was going to grease the motor would stamp it. That part was all right, and then along came the war and there were a lot of motors that were not used. Still every six months those motors were greased whether they were used or not. Finally the motors got so full of grease that when we sent them down to the repair shop, all they had to do was take 2 bolts out and the end belt would fly off.

Wm. E. Reiber: What I primarily meant, do you carry one spare motor for a total of 10 of the same kind, or a total of 20?

Fred Groven: We try to carry one for every 15. It is pretty hard to do that, you know, because the repairs on these motors vary so. In the summer time, you have more trouble than you do in the winter. You can hit a balance along that line pretty well in the winter time, but when the hot summer months come, you run into more trouble. I am hoping that the motor manufacturers will make a totally enclosed motor, not fan cooled, in the same frame size, so we can use a fire hose to clean it. That is what we are after now, and we are just going to keep working after these fellows until we get it. In fact, I have one already!

Wm. E. Reiber: With the kind of starters you spoke about, do you favor the kind that when you pull the switch you actually see the blades open, or the kind when you pull the switch you do not see the blades open?

Fred Groven: When you pull the switch handle on the starter you do not see blades. You pull your switch handle, and the lock interlocks with the cover, and the only place that is alive is the little point at the top where the service comes in and those are pretty well guarded, so that a fellow would actually have to put his hand in there in order to get in contact with the power.

Wm. E. Reiber: Can you see the open blades?

Fred Groven: The open blades are dead and can be seen after cover is open.

Wm. E. Reiber: How do you go about, or do you have a schedule on changing cables on ladle cranes?

J. C. Walker: In answer to that question, we have a cable inspector and the cables are inspected daily. A micrometer check on the outside diameter dimensions of the cable will reveal any diminishing of the cable centers. Also all cables received a visual check on broken outside strands, and if there are as many as seven broken outside strands, the cable is replaced, even if the micrometer test reveals the outside diameter dimensions are all right.

Wm. E. Reiber: You do not count the number of heats or keep a record of the heats this cable handles?

J. C. Walker: No.

Wm. E. Reiber: You take it by the check of the cable?

J. C. Walker: Yes.

General Maintenance

By A. CULLEN

Superintendent of Maintenance, Steel Division

Ford Motor Co.

▲ AS an integral part of the "Ford team," we will discuss mechanical maintenance in the steel division and its relationship to care of equipment, mill delay, nature of repair and remedial measures.

Maintenance has been defined as the work of keeping plant equipment in good running condition. Due to our experience from increased demands for more steel, changes in production and production schedules, the definition needs alteration.

Then, if mechanical maintenance is the work of keeping plant equipment running, maintenance is an essential aid to increase production.

A strip mill, for example, where roll changes are numerous and a large amount of assembly and repair work is entailed and where lubrication systems are installed, will require a larger crew of men than a small merchant mill. Similarly, a steel mill will require a larger maintenance crew than a fabricating plant. Continuity of operation is a major factor.

This is promulgated by conscientious work on the part of the men, cooperation, and good training for departmental maintenance crews. Love of machinery, a pride in its appearance and performance, and a pride in a job well done marks the good maintenance man. If your men and my men are not doing the quality of work that is expected, we should decide upon a procedure of training them, that is, inspection routine should be definite, the working methods should be clearly understood, and safety practices definitely set down. Every employee should be familiar with these definite procedures and understand that they must be carried out. With this as the basis, qualified men can be depended on to use common sense judgment in meeting any situation which arises.

The ability to decide quickly upon the most effective means of making a repair is often the governing factor on a breakdown. The time of an emergency is not the time for consultation and argument.

Decisive action is obtained only by correct training methods and experience. A good practice is to review repair jobs and discuss these with the men. Errors can be pointed out, corrections made, and improved methods of procedure used.

In order to keep our steel division in running order, inspection is essential. Everyone wishes that the maintenance foreman could foresee breakdowns and do something about it before a delay is caused. No one wishes for this more than the maintenance man himself. His work increases ten-fold when trouble reaches the breakdown stage. Inspection cannot be haphazard or lackadaisical; to be effective it must be orderly. systematic, and periodical. To achieve this objective, zoning is required and responsibility for the zone must be definitely established.

What is the significance of the phrase, "ready to use"? A spare part should not be considered as a spare unless it is assembled to the point where the least time is required to replace it when trouble is encountered. In one department, a bare shaft might be adequate as a spare for one in a certain reduction unit, whereas in some other department the entire reduction unit completely assembled should be required. The determining factors are questions of invested capital, how much is lost by tieing up the mill, and can lost production be recovered. As to lost production, that is never recovered.

The best lubricant, the best oil or grease system, and the most conscientious employee cannot compete against mill scale, water, poor design, and faulty machinery practice unless these factors are properly controlled and their importance appreciated.

This brings us to the consideration of design and its significance to the maintenance man. You have heard mechanics say, "If the fellow who designed this could be here trying to fix it, he would not design another one this way." Often that is the case. Designers in their desire to make a workable machine often overlook the fact that sometimes it must come apart to be repaired; that someone will be waiting for its return to production and someone else is trying to repair it. This results in changes being made in many pieces of equipment after a grief is encountered.

The days of tallow, common engine oil, and ordinary black oil for practical easy application, are past. Lubrication has not only gone through the study stage, but has become a highly technical profession requiring wide experience and knowledge. The question may be asked, are we using our experience and if so to the fullest extent? Are we using the best that is at our disposal? If not, then the quality of our work is poor and we are not doing the type of work that is described in the job description.

We have all heard the words, "Burned out, lack of oil," but we still need to understand that some of our equipment is burned out not through the lack of oil but through the use of the wrong lubricant. This problem

is difficult because in some cases fair service is received in some units and we do not realize that longer life is possible.

The very nature of maintenance work seems to breed a courageous spirit and a dogged determination to cure the ills which have been considered inherent in machines and equipment. Successful maintenance consists of two elements, "when" and "how." A great deal of self-satisfaction is in store for the man who knows "when" and "how."

The cost of maintenance is certainly as much a final cost as the cost of any raw materials entering into the end product. One of the problems of maintenance is to reduce the cost of maintenance. Your assistance is needed, for by so doing, the production cost will be decreased and production increased. Increased production will come from the mental attitude of the mill operators when they have machinery and equipment in the best possible operating order. Maintenance, like taxes, is always with us, and all industry is becoming more and more maintenance conscious. Sometimes maintenance is looked upon as one of the necessary evils in the life of any piece of equipment. Failures are bound to occur unless certain things are done during the normal course of mill operation. There has from time to time been a tendency to perform these jobs with a lick and a promise.

The maintenance of boilers, pumps, motors, turbines, piping, heaters, furnaces, mills and all the other various equipment is a recurring, ever present, endless job. If maintenance that should be done today is not done, there will be just that much more to do tomorrow. Today it is a simple job; tomorrow it is another story. Tomorrow is the day when broken parts fly and the air is incensed with strong words. Suggestions by employees which may improve methods or procedures should always be considered.

Too much stress cannot be placed upon this point when a report of an unusual or questionable condition is presented. Do not fail to act on it; otherwise the man who makes the report will become discouraged or disgruntled and think that there is no use of making reports when nothing is done about them.

It is axiomatic that to buy cheap is to buy dear. In these days of safety consciousness, it is sometimes difficult to determine which is the most important, a perfect safety record or a perfect production record, undeniably, they go hand in hand. If a plant is so maintained that failures are at a minimum, accidents to personnel will be at a minimum and production at a maximum. To consider only the initial cost of an installation without record to total maintenance cost is faulty reasoning and false economy.

We have equipment installed to meet a production schedule that is at a high figure. The failure of a part will cause mill delays. The material that goes into these parts is of prime concern to the mechanical maintenance man. The service of parts must be of long duration. The selection of high quality parts is good practice and good planning. Poor equipment is expensive. I want to assure you men that the equipment in our plant is the best. There is none better. Time and again we remove gears after twenty-five years of service and tool marks are still in the steel. This equipment has not only been well selected but it has been well serviced and operated by competent men.

No matter what the nature of the work or the type of equipment, preventative maintenance pays. In your own home you oil the washing machine and vacuum cleaner and if you see sparking you check the commutator and brushes. Why? To keep them working for a longer period of time without breakdown, to lengthen their useful life span. We are the men who must see that all necessary details are covered each day in order to feel confident that we are able to contribute our share to smooth continuous operation. If there is any reason as to why we are supervisors, I believe that is it. If we shirk our responsibility we can expect the same from the men with whom we are working.

Orderliness and Cleanliness

By E. C. White

Metallurgical Engineer, Metallurgical Department

Ford Motor Co.

▲ THE question of cleanliness and orderliness, I like to visualize as an iceberg, there is a whole lot more below the surface than what you can see. When you realize that over half of a workman's waking hours are spent on his job, then we realize what this problem of working conditions mean. In addition there are two or three points that come to your mind connected with cleanliness, orderliness, and safety. It is not necessary to say anything about the importance of cleanliness and orderliness connected with safety. One has only to visualize the leaking of an oil line over a dark stairway, a conglomeration of waste and dirt in corners, and it is obvious that that would cause fire hazards and lost employment.

Skipping to the matter of morale, every man in industry likes to have the feeling of well being. In other words, he likes the place he works to give him that feeling of well being, and much has been done along that line. I understand that one company actually put in a laundry system to launder the men's clothes. It worked fine for a while, but it was not very long before they were coming in with bundles from home. Maybe they have something there, and it may be the way to win over the lady at home.

However, the foreman and the supervisor must be the leader in any program of orderliness or cleanliness. He must furnish the leadership. He must get that cooperation that we all know is necessary. In Thompson and Morris publication on Business Management they had a simile in there that I think is good. They spoke about men being the material with which to build, that loyalty is the foundation on which you build, and cooperation is the mortar with which you tie the building together. Now, why cannot we do our building well?

USING OXY-ACETYLENE FOR STRAIGHTENING, FORMING, AND CLEANING STRUCTURAL STEEL

. . . . distortion due to welding can be easily removed and desired distortions or camber can be easily introduced by the use of the oxy-acetylene flame . . . .

By F. H. DILL
Welding Engineer
American Bridge Co.
Ambridge, Pa.

▲ SINCE the introduction of the oxy-acetylene cutting torch and its companion, the welding torch, to the structural fabricating industry over forty years ago, there has been ever increasing use of the oxy-acetylene flame to perform old tasks more easily and to accomplish work that is beyond the reach of other tools. Local heating of parts for mechanical straightening or hot bending is a use that developed because it could save time. Straightening complicated pieces and assemblies solely by ingenious local heating, and the corollary process of forming or cambering steel parts by local heating, save time and cost, and accomplish results that could not be attained otherwise without tremendously large and costly machinery. Cleaning structural steel with oxy-acetylene flames before it is painted creates uniquely beneficial characteristics in the paint film and its adherence to the steel.

The most obvious advantages of the oxy-acetylene flame are its portability, and its ability to reach places that are inaccessible to other tools. In the structural fabricating industry where the finished structures, their individual members, and even the parts of members, are large and heavy, the scheme of bringing tools to the work is always attractive. The very general use of portable pneumatic and electric tools in both the shops and the field erection work of the industry exemplifies this. Under such circumstances, the extremely portable oxy-acetylene flame has had increasing use in the structural steel industry as needs for it have arisen and as men have invented new applications and proved their merits.

Fortunately most of the steel used for bridges, buildings, and similar structures is not harmed by the thermal shock of steep temperature gradients within it. It can, therefore, except when it is very thick or very cold, absorb the full force of the intense oxy-acetylene flame. This fact is recognized now in specifications that govern the fabrication of bridges and buildings and it is becoming less often necessary to demonstrate to engineers that application of the flame does not damage the steel metallurgically.

Presented before Annual Meeting of International Acetylene Association, Pittsburgh, Pa., April 25, 1949

An early and still important use of the oxy-acetylene flame in structural work is for heating steel to visible red heat so it can be straightened with hammer blows. This permits parts, such as connection angles and light flanges that stand out from large members and are often bent in handling, to be straightened without moving the piece to a machine. It saves both time and expense. A similar application appears in the final setting to accurate dimensions of pieces that have been bent in presses. The flame eases and speeds the work.

A more recent use of the oxy-acetylene flame has been for locally heating steel to hot bending temperatures preparatory to bending in a press or by other mechanical means. This application, which is possible where there is a plentiful supply of low cost acetylene, pits the rapid heating of the oxy-acetylene flame against the slower more soaking heat of less expensive fuels burned in torches or in open top, slot-type furnaces. Heating time is reduced and sharper bending and more accurate location of bends can be attained. Heating time is reduced directly by the rapid heating rate of the intense oxy-acetylene flame, but there is further saving of time and fuel because a short heating time minimizes the loss of heat into contiguous metal that is not necessary to heat.

Sharper bending and more accurate location of bends result from the ability to heat only the metal which must be deformed in bending. It is very important, however, in this use of the oxy-acetylene flame to heat sufficient metal to permit bending without excessive reduction in the thickness and width of the piece being bent. For unsymmetrical sections this demands heating of triangular or trapezoidal shaped areas.

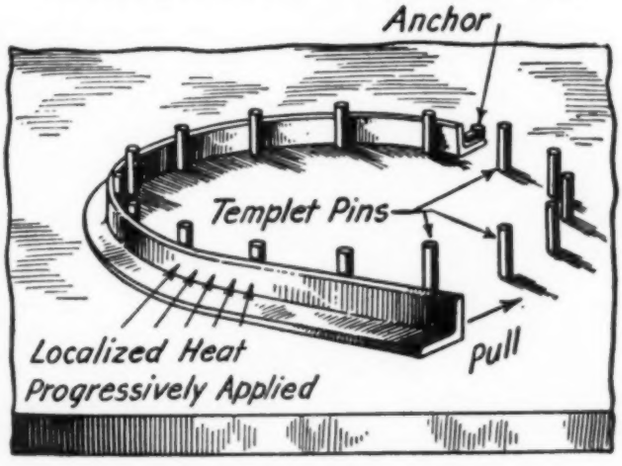
Another very important precaution for this method of heating for bending or for any other scheme of local heating is to avoid heating to temperatures of 400 to 700 F any steel that has been severely cold-worked, as by cold-forming, punching, or shearing. Inattention to this precaution can allow the development of strain-aging and consequent brittle fracture of the steel. An example of this can be cited from the records of a large fabricating shop in the fracture of several 8 x 8 x 1⅛ in. flange angles for girders. The angles were punched and

then curved by cold-forming before they were torch-heated for making a sharp angular bend. They broke in brittle manner through punched holes about a foot from the center of the bend while they were being fitted and assembled with the web and other parts of the girders.

The wide acceptance of flame-cutting and welding as practical methods for the fabrication of structures has provided great impetus to the use of the oxy-acetylene flame for straightening and forming steel. When rivets are used for connecting the elements of a structure there is seldom need for straightening or fairing completed members or assemblies. Flame-cutting and welding, however, both involve intense local heating of the steel and inherently cause shrinkage of the metal. It is natural to fight fire with fire and the intense oxy-acetylene flame has come into use for creating balancing shrinkages that produce straight members and fair structures. Technical studies have explained how shrinkage develops from upsetting heated metal against the restraint of surrounding cold metal so that it is thicker and shorter after it has cooled. Workmen with torches in their hands have developed skills that make practical use of this phenomenon.

During the tremendous war-time construction of ships the fairing or flattening of plating by local heating received much attention. Checkerboard patterns of spots and zebra-like stripes were common sights in the shipyards. They displayed the shipbuilders' solution to the problem of eliminating the buckles that formed in rectangular panels of thin plating that had been shrunk at the boundaries of the panel by the welding which attached the plating to the skeleton of the ship. Heating spots about an inch in diameter to visible red heat on a checkerboard pattern in the buckled panels created an accumulation of small shrinkages which, in total, equalled the weld shrinkage around the borders of the panel and drew it flat. Some shipyards preferred lines of heat to rows of spots and some yards used both. Often the cooling of the heated metal was accelerated by directing small jets of water or air-water sprays against it to speed the work and to increase the shrinkage of each spot. In all of the work, however, the man using the torch had to judge the "temper" of the buckle and skillfully fit the amount and location of heating and accelerated cooling to the individual conditions of each panel.

This sketch shows a method for forming angle iron. Any suitable templet or pattern can be used. (Welding and Cutting Manual, The Linde Air Products Co.)

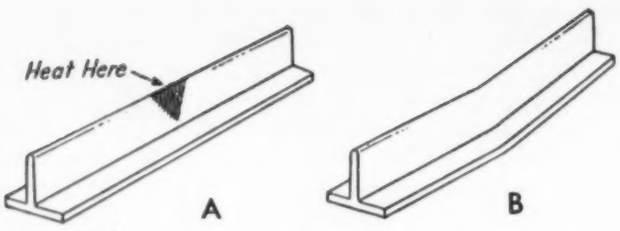


In the fabrication of large structures and structural members by welding there are often detail or overall distortions from the dimensions that the completed pieces are required to have. The pieces are usually too bulky to fit into presses for correction of their dimensions and many of them are beyond the reach or capacity of mechanical methods of straightening. Practical experience has shown that heating to produce shrinkage along lines parallel to and opposite to the welds permits the necessary correction to be made quickly and easily and without moving the structure or member far out of its usual path through the shop. Girder flange plates 2½ in. thick, for example, that are curled by the welding that connects them to the girder web can be made flat and square with the web by heating them along the center of their outer face with a large multi-flame oxy-acetylene torch moving along the girder at a speed of 6 to 12 in. a minute. Connection plates at the ends of beams and trusses can be similarly straightened and the flanges of wide-flange beams can be made square with the web by judicious heating. Experience in at least one plant has shown that the shrinkage effects of local heating can sometimes be used to straighten plates that would break if they were straightened by hammer blows or other mechanical means. Contrariwise, it has also been demonstrated that excessive or improper application of heat shrinkage can tear steel apart.

Many persons may be surprised to learn that expansion of the nation's highway system has promoted a very large use of the oxy-acetylene flame. The motorist's demand that small bridges be practically unobservable as he crosses them has engendered the development of bridges made of long rolled beams cambered or curved vertically to fit the contour of the roadway. The cambering of large beams that is offered by the steel mills is not accurate enough for this use and it often does not fit the dimensions that are required by the engineering designs. It was natural, under these circumstances, for shop men familiar with the power of oxy-acetylene flame to apply it to the job of providing accurate camber that could not be obtained by other methods.

The basic principles of cambering beams by heat shrinkage are quite well established. The beam is set upside down with supports under its ends only. Heat is then applied to the uppermost flange (the flange which will be the bottom flange in service). The beam first arches upward under the influence of the expansion of heated metal, but as the flange cools the shrinkage that accompanies local heating will shorten the flange and the beam will curve downward toward the camber that is desired. Skill and experience are required to judge from the behavior of the beam, as it is heated, the amount of heating necessary to obtain the specified camber.

An early method of heating the flanges of beams that were to be cambered was to heat several zones about 3 in. wide across the entire flange so that the steel was at bright red heat throughout its thickness. In this scheme the weight of the beam was a major factor in upsetting the heated metal and the number of zones heated



This shows how heat can bend steel. If you heat a beam in the marked spot A, it will bend as shown in B. (Welding and Cutting Manual, The Linde Air Products Co.)

largely governed the amount of camber produced. The cambered shape was a broken curve of straight segments with a small but sharp bend at each heated zone. The scheme was satisfactory for cambering beams with very wide flanges that were only 14 to 16 in. deep, but it was not effective for larger beams, even when weights were set on the beam to increase the upsetting of the heated zones. It has been found, however, that this general idea can be made effective for large beams if the heated zones of the flange are extended over a distance equal to half the depth of the beam and if the web at each zone is simultaneously heated in a triangular area extending from the heated zone of the flange to the center of the web. This is still a fairly common method of heating beams to camber them but it is rather slow and expensive.

Searches for faster and more economical schemes for heating the flanges of beams and for means of producing smoothly curved cambers have led to the use of longitudinal heating of the beam flanges to subcritical temperatures. Initial trials of this scheme were made with extremely large multi-flame heating torches and with the heated zones intermittent along the length of the flange. Recent work, however, has been with torches of about 250 cfhr capacity making continuous lines of heat. Control of the amount of heat supplied is gained primarily by skillful adjustment of the speed at which the torch travels, but secondary control is had from adjustment of the size of the flames and the distance from the torch tips to the work. The number and arrangement of the torches across the beam flange is chosen to suit the dimensions of the beam being cambered.

One shop has recently cambered a large number of 16-in. wide-flange beams with 2¾-in. camber in 40 ft. Another shop has obtained a camber of 11 in. in 36-in. wide-flange beams 80 ft long. Cambers of 1½ or 2 in. can be put into beams with less than an hour's work by a single workman. Camber or curvature of only part of the length of a beam can be provided if it is needed and, by heating the upper and lower sides of each flange simultaneously near one edge, beams can be curved laterally to fit engineering or architectural requirements.

The development of new types of paint vehicles 10 to 15 years ago was a prime factor in creating a new use for the oxy-acetylene flame. The new paints had different drying characteristics than the paints traditionally used in the structural industry and they required more thorough cleaning and drying of the steel surfaces before the initial or prime coat of paint was put on. Sand-blasting was tried, but it was very expensive and it did not provide the extra dryness that was needed. Experiments with steel that had been warmed just before it was painted showed promising results and the oxy-acetylene flame, with its inherent portability and flexibility, was put in use to provide similar conditions on steel in structural shops. Special comb or ribbon burners were developed, with particular attention being directed to providing the highest possible flame velocity and intensity, and trials of other fuel gases showed that only the oxy-acetylene flame could accomplish the desired results. It was found that the cost of flame-cleaning steel in preparation for painting was less than half that of sand-blasting. The nuisances of sand-blasting were eliminated and a thoroughly dry and warm surface was presented for the prime coat of paint.

Specifications which define flame-cleaning as a unique process involving the following four separate operations have been adopted by the American Institute of Steel Construction so that the process can be distinguished from descaling processes and can be held to accomplishment of its intended results in commercial use:

1. Oil, grease, and similar materials are to be removed with solvents.
2. The surfaces of the steel are to be cleaned and dehydrated by the passage of the special oxy-acetylene flames. (This operation drives absorbed moisture from the surfaces and also breaks away partly loosened mill scale and rust.)
3. The surfaces are to be wire-brushed and then swept with soft brushes to remove loosened scale, dirt, and dust.
4. Paint is to be applied promptly and while the temperature of the steel is still above that of the surrounding atmosphere.

The paint on bridges that have been flame-cleaned in preparation for their prime coat of paint has given good service during the last ten years and appears to substantiate the claims of merit that are made for the process.

All of these uses of the oxy-acetylene flame require large amounts of acetylene and they are most economical where there is adequate supply of low-cost acetylene from piped distribution systems. Some of the uses demand such volumes of the gas that they are not feasible where the acetylene must be taken from cylinders. The availability of low-cost oxygen from piped distribution systems also enhances the value of the various processes and makes them practicable in commercial work.

The uses of the oxy-acetylene flame that have been reviewed are those apart from welding, flame-cutting, and the flame-softening of flame-cut edges of hardenable steels. There has not been any attempt to list all of the applications that are made in straightening, forming, and cleaning structural steel, but it can be remarked, in conclusion, that use of the oxy-acetylene flame provides the structural fabricating industry with a tool that has an unsurpassed combination of portability, flexibility, and power. Use of the flame has proved economical, and it accomplishes many tasks that have never been done by other equipment and processes.

1949 ANNUAL CONVENTION

ASSOCIATION OF IRON AND STEEL ENGINEERS

HOTEL WILLIAM PENN

PITTSBURGH, PA.

OCTOBER 3, 4, 5 and 6, 1949

To Steel Mill Engineers and Operators . . . .

With the ending of the seller's market in steel has come the need of exercising greater ingenuity and resourcefulness in bettering the economy of the industry's production processes. Stronger competition will call for improved quality and better operating efficiency, and these needs fall upon the shoulders of the engineering and operating personnel of the iron and steel industry.

To help meet these responsibilities, the Association of Iron and Steel Engineers is continuing to maintain its program of activities designed to inform the supervisors of the industry of the latest developments in equipment and processes. An important event in this program is the 1949 Annual Convention to be held in Pittsburgh, October 3, 4, 5 and 6.

This meeting embraces approximately forty technical papers and two inspection trips, and I am very glad to be able to invite the engineers and operators of the steel industry to attend this excellent program. You will be welcome and I am sure you will profit by participating.

C. H. WILLIAMS,
President, AISE.

1949 Annual Convention

HOTEL WILLIAM PENN

PITTSBURGH, PA.

OCTOBER 3, 4, 5 and 6

Program

Monday, October 3

9:00 a.m. — REGISTRATION—Fort Duquesne Room

9:00 a.m. — LADIES' REGISTRATION AND HEADQUARTERS — Parlor E-F

9:15 a.m. — BUSINESS MEETING — Urban Room
Conducted by President C. H. Williams

9:30 a.m. — ELECTRICAL SESSION — Urban Room

Chairmen: J. D. O'ROARK
Weirton Steel Co.
J. H. FRANZ
Carnegie-Illinois Steel Corp.

"The Mill Motor After 45 Years," by S. S. Burns, Crocker-Wheeler Division of Elliott Co.

"Cold Rolling of Tinplate," by G. E. Stoltz and J. W. Brinks, Westinghouse Electric Corp.

9:30 a.m. — COMBUSTION SESSION — Monongahela Room

Chairmen: H. S. HALL
Lukens Steel Co.
E. T. W. BAILEY
Steel Company of Canada, Ltd.

"Advances in Automatic Control of Multiple Fuel Firing in Steel Mill Boiler Plants" by M. J. Boho, Hagan Corp.

"Operating Advantages and Limitations of Open Hearth Controls," by B. B. Bargman, Carnegie-Illinois Steel Corp.

"Experience in Oxygen Flow Measurement," by C. W. Parsons, Republic Flow Meters Co.

ALL EVENTS WILL BE HELD ON THE 17th FLOOR OF THE HOTEL WILLIAM PENN

2:00 p.m. — ELECTRICAL SESSION — Urban Room

Chairmen: A. D. HOWRY
Alan Wood Steel Co.
R. L. LIVINGSTON
National Tube Co.

"Design and Maintenance of Crane Runways," by V. L. Smith, Fort Pitt Bridge Co.

"Recent Developments in the Design of Coal and Ore Bridges," by B. A. Rose, Heyl and Patterson, Inc.

'Sliding Contacts for Transfer of Electrical Energy for Industrial Systems," by H. Yale Mageoch, Electric Service Manufacturing Co.

2:00 p.m. — ROLLING MILL SESSION — Monongahela Room

Chairmen: JAMES N. IMEL
Jones and Laughlin Steel Corp.
CHARLES HAMMOND
Rotary Electric Steel Co.

"Rail Slitting Mills," by C. W. Barrett, Republic Steel Corp.

"Continuous Merchant Mill," by L. C. Sowell, Jones and Laughlin Steel Corp.

"Pass Design for Angular Sections," by Ross E. Beynon, Carnegie-Illinois Steel Corp.

3:30 p.m. — LADIES' TEA AND RECEPTION — Fort Pitt Room

Tuesday, October 4

9:00 a.m. — COMBUSTION SESSION — Monongahela Room

Chairmen: C. E. DUFFY
Bethlehem Steel Co.
GEORGE H. KRAPF
Carnegie-Illinois Steel Corp.

"High Speed Heating and its Implications for the Steel Industry," by Frederic O. Hess, Selas Corp. of America.

"Construction and Maintenance of Open Hearth Furnace Bottoms," by C. William Conn, Ford Motor Co.

"Checker Brick Design, Construction, and Use," by Jay J. Seaver, Jay J. Seaver Engineers.

9:00 a.m. — STANDARDIZATION SESSION — Urban Room

Chairmen: F. W. CRAMER, Chairman
AISE Standardization Committee
L. J. GOULD
Bethlehem Steel Co.

"Standardization Report," by F. W. Cramer

"Final Report of AISE Crane Wiring Standardization Committee," by C. G. Dimitt, Co-Chairman, AISE Crane Wiring Standardization Committee.

"Progress Report of AISE-NEMA Committee on Brake Standardization," by V. E. Schlossberg, Chairman, Joint AISE-NEMA Committee on Brake Standardization.

"Report on Carbon Brush Standardization," by Hugh Conover, Chairman, Carbon Brush Standardization Committee.

"Specification for Design of Ladle Hooks," by William H. Mursch, Chairman, Design of Ladle Hook Committee.

11:30 a.m. — LADIES' LUNCHEON
(Meet at Ladies' Headquarters)

1:30 p.m. — INSPECTION TRIP TO IRVIN WORKS, CARNEGIE-ILLINOIS STEEL CORP.

6:00 p.m. — OLD TIMERS' DINNER — Fort Pitt Room

Wednesday, October 5

9:00 a.m. — ELECTRICAL SESSION — Urban Room

Chairmen: V. E. SCHLOSSBERG
Inland Steel Co.
R. W. GRAHAM
Bethlehem Steel Co.

"Supervisory Control and Telemetering as Cost Reduction Tools," by E. Wylie Head, Control Corp.

"A Static Magnetic Amplifier for Regulating Circuits," by H. E. Larson and T. Dunnegan, Jr., General Electric Co.

"The Mechanical Rectifier," by Otto Jensen, I-T-E Circuit Breaker Co.

9:00 a.m. — MECHANICAL SESSION — Monongahela Room

Chairmen: EMIL KERN
Allegheny Ludlum Steel Corp.
P. L. WALTER
Republic Steel Corp.

"Steel Plant Maintenance," by S. D. Baumer, Air Reduction Sales Co.

"Mill Building and Equipment Painting," by Warren W. Scherer, Carnegie-Illinois Steel Corp.

"Couplings for Rolling Mill Drives," by W. P. Schmitter Falk Corp.

1:00 p.m. — GENERAL SESSION — Ball Room

Chairmen: C. H. WILLIAMS
Carnegie-Illinois Steel Corp.
A. S. GLOSSBRENNER
Youngstown Sheet and Tube Co.

An address by M. W. Reed, Vice-president, engineering, United States Steel Corp.

2:00 p.m. — MATERIAL HANDLING SESSION — Urban Room

Chairmen: R. P. TOOKE
Armco Steel Corp.
T. M. FAIRCHILD
Bethlehem Steel Co.

"Materials Handling in Steel Plants," by L. Russell Astie, Jones and Laughlin Steel Corp.

"Relation of Materials Handling to Production," by James S. Freese and Frank C. Wier, The Timken Roller Bearing Co.

"Developments in Coil Conveyor Equipment Design," by L. O. Millard, Link Belt Co.

2:00 p.m. — LUBRICATION SESSION — Monongahela Room

Chairmen: C. E. PRITCHARD
Republic Steel Corp.
A. CICHELLI
Bethlehem Steel Co.

"The Action of Cutting Fluids in Machining," by Dr. M. Eugene Merchant, The Cincinnati Milling Machine Co.

"Steel Plant Lubrication Training," by William M. Schuck, Armco Steel Corp.

"An Evaluation of Oil Purifiers for Steel Mill Service," by J. I. Clower, University of Delaware.

7:30 p.m. — FORMAL DINNER AND DANCE — Ball Room

Thursday, October 6

9:00 a.m. — OPERATING PRACTICE SESSION — Urban Room

Chairmen: P. E. HAGLUND
Ford Motor Co.
R. H. GELDER
Armco Steel Corp.

"Reviewing Progress in Pressure-Blowing Blast Furnaces," by Frank Janecek, Republic Steel Corp.

"Increased Open Hearth Production by Improved Charging Methods," by R. Tietig, Jr., A. J. Boynton and Co.

"Controlled Cooling of Steel Blooms in Car-Bottom Furnaces," by C. J. F. Burch, Carnegie-Illinois Steel Corp.

9:00 a.m. — LUBRICATION SESSION — Monongahela Room

Chairmen: N. I. WHITELEY
American Steel & Wire Co.
R. A. KRAUS
Republic Steel Corp.

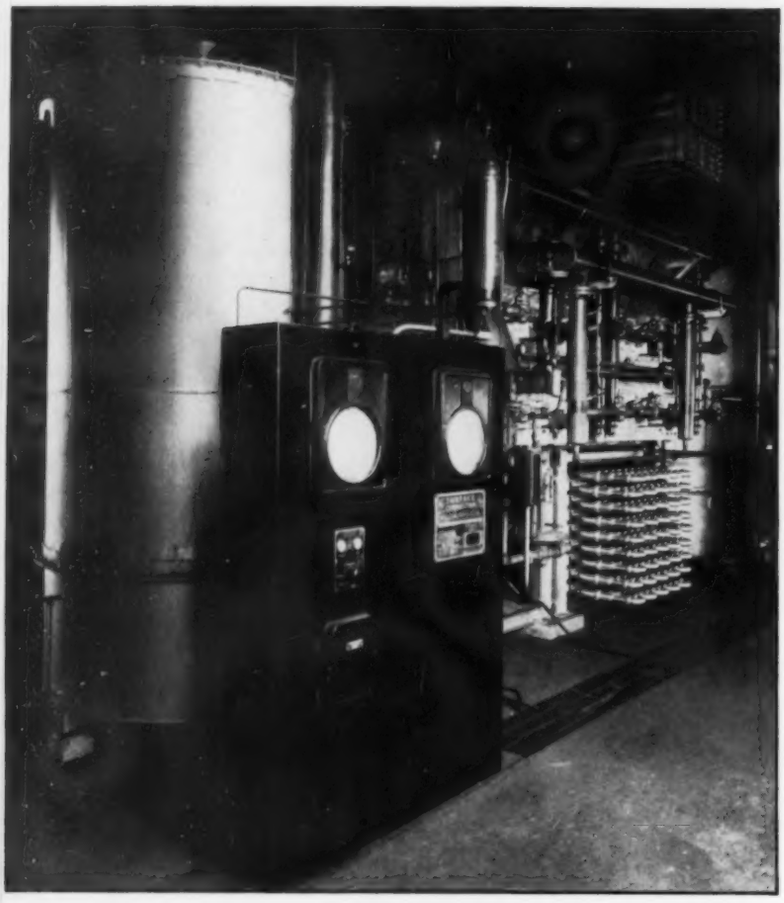
"Considerations in the Development of Roll Neck Oil Seals," by Edw. W. Fisher, Garlock Packing Co.

"Bearing Inspection and Repair," by C. T. Lewis, Republic Steel Corp.

"Relationship of Preventive Maintenance and Roller Bearing Application," by J. A. Toth, The Torrington Co. Bantam Bearings Division.

1:30 p.m. — INSPECTION TRIP TO ALIQUIPPA WORKS, JONES AND LAUGHLIN STEEL CORP.

INSPECTION TRIPS



TUESDAY, October 4

CARNEGIE-ILLINOIS STEEL CORP.

IRVIN WORKS
DRAVOSBURG, PA.

•

Buses will leave Grant Street entrance of Hotel William Penn, Pittsburgh, Pa. at 1:30 p.m., sharp.

•

Partial over-all view of one of the four controlled atmosphere generators that supply inert atmosphere gas to the annealing furnace at Irvin Works.

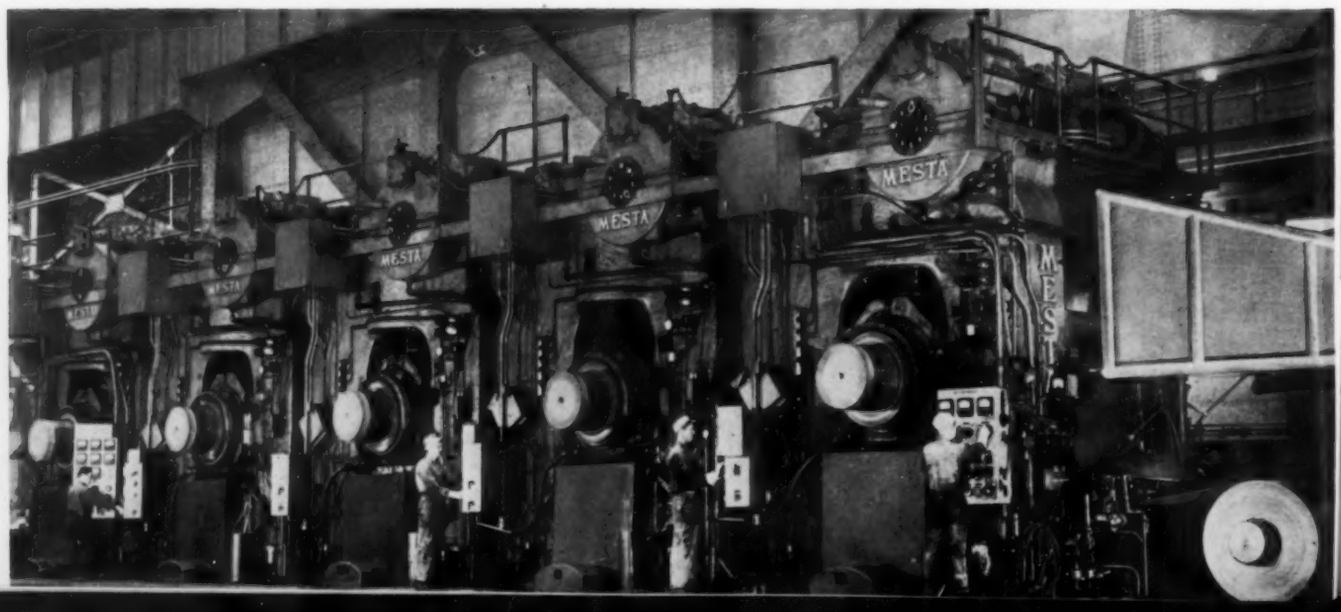
THURSDAY, October 6

JONES & LAUGHLIN STEEL CORP.

ALIQUIPPA, PA., WORKS

Buses will leave Grant Street entrance of Hotel William Penn, Pittsburgh, Pa., at 1:30 p.m., sharp.

View of the world's fastest 42 in., 5-stand tandem cold strip mill at Aliquippa Works, Jones & Laughlin Steel Corp.



Authors

1949 AISE Annual Convention

L. R. ASTIE

B. B. BARGMAN

C. W. BARRETT

S. D. BAUMER

ROSS E. BEYNON

M. J. BOHO

C. J. F. BURCH

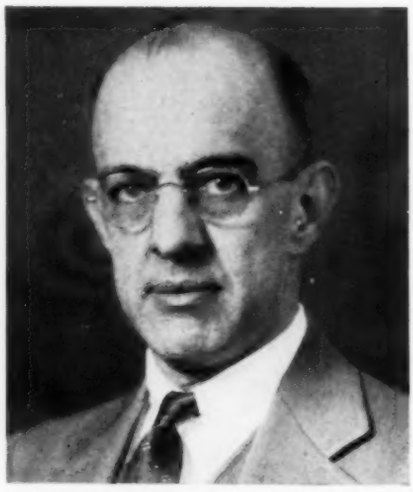
S. S. BURNS

J. I. CLOWER

Authors

C. W. CONN

HUGH CONOVER



FRANK CRAMER

T. DUNNEGAN, JR.

E. W. FISHER

JAMES S. FREESE

E. WYLIE HEAD

FREDERIC O. HESS

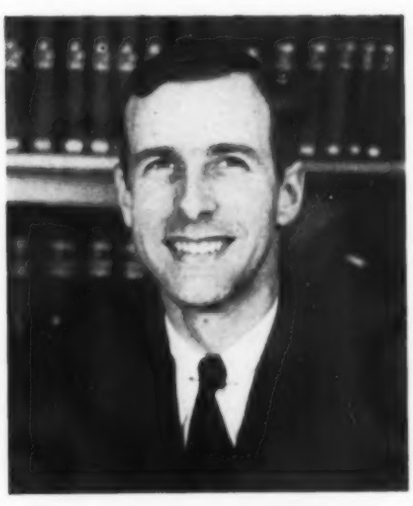
1949 AISE Annual Convention

OTTO JENSEN

H. E. LARSON

C. T. LEWIS

H. YALE MAGEOCH



DR. M. EUGENE MERCHANT

WILLIAM H. MURSCH

CHARLES W. PARSONS

M. W. REED

Authors

B. A. ROSE

WARREN W. SCHERER

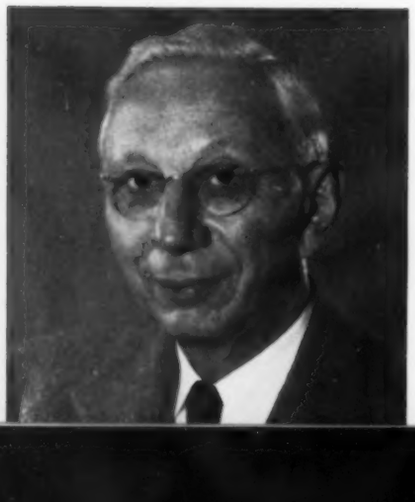
WILLIAM SCHUCK

JAY J. SEAVER

V. L. SMITH

L. C. SOWELL

G. E. STOLTZ



JOHN A. TOTH

FRANK C. WIER

Abstracts of Papers

To be presented at

AISE ANNUAL CONVENTION

HOTEL WILLIAM PENN

PITTSBURGH, PA.

OCTOBER 3, 4, 5 and 6

COLD ROLLING OF TINPLATE

by G. E. STOLTZ and J. W. BRINKS, Westinghouse Electric Corp., East Pittsburgh, Pa.

▲ THE paper gives results of a test made on a 5-stand tandem cold reduction tinplate mill rolling at speeds of 3500 to 5000 fpm. Graphic charts were obtained showing armature current, voltage, and speed of the individual driving motors as well as tension between stands, roll pressure, and thickness of strip out of No. 1 and No. 5 stands. The power consumption expressed in horsepower hours per ton checks closely with that obtained on slower speed mills.

The graphic curves of armature current show that the motor on the first stand requires little increase for acceleration while that on No. 5 stand is relatively large. During deceleration the armature current on No. 5 stand motor decreases to almost zero, and sometimes regenerates.

During the first test made, the tension between stands increased approximately 50 per cent when the mill was slowed down to threading speed. This applied to the tension between all of the stands. Later the operators manipulated the screws on No. 1 stand and materially increased the tension between 1 and 2 during the slow-down period which resulted in greater reduction being made in the thickness of the strip at the entry into the mill. Instead of obtaining 50 per cent increase in tension between stands 4 and 5 with this changed method of rolling, the increase in tension between 4 and 5 did not exceed 15 per cent when rolling some of the schedules.

This also tended to maintain gage for a longer period and minimized the over-gage obtained at slow speed.

Roll pressures decreased during the slow-down period which is contrary to what was expected. It was first assumed that obtaining over-gage would tend to increase the roll pressure during the slow-down period, but the graphic charts show that the roll pressure decreases as the mill slows down. This is of considerable interest.

THE MILL MOTOR AFTER FORTY-FIVE YEARS

by S. S. BURNS, Design Engineer, Crocker Wheeler Electric Manufacturing Co., Division of Joshua Hendy Corp., Ampere, N. J.

▲ IT is well understood by everyone interested in steel mill motors that the new 600-series, as standardized by the AISE in 1947, offers the industry motors of the same dimensions as, and mechanically interchangeable with the previous series, but with the next higher rating developed in each size, from the 602 with 7½ instead of 5 hp to the 618 with 200 instead of 150 hp.

It is probably not quite so well understood how this has been accomplished; or how it has been possible to so considerably reduce the overall size of a motor for a given rating with no increase in temperatures, and with definitely improved performance.

Using to the full the accumulated experience of forty-five years since the author's company pioneered the first "steel-mill" motors, and incorporating the up-to-the-minute ideas of the users, the new motors not only give better performance but include many improvements in details of manufacture and construction to improve accessibility, reduce maintenance and give maximum life.

In addition to the AISE standardized features which include among others the solid cylindrical roller bearing, improved pinion gear tooth design, liberal radius at shaft extension and smaller space; the paper discusses the following mechanical and electrical features which demonstrate the definite advance over their bulkier predecessors they replace:

1. Lower losses—higher efficiency.

2. More effective cooling.
3. Improved insulation.
4. Better commutating ability and greater overload commutating capacity.
5. Desirable accessibility.
6. Minimum maintenance.

ADVANCES IN AUTOMATIC CONTROL OF MULTIPLE FUEL FIRING IN STEEL MILL BOILER PLANTS

by M. J. BOHO, Vice President, Hagan Corp., Pittsburgh, Pa.

▲ THE use of combination firing has been carried further in the steel industry than in any other. All new boiler installations incorporate automatic combustion control for this purpose as an integral part of the initial design. As a result, three major benefits are realized:

1. An ample supply of steam at desired pressure and temperature is assured without excessive operating attendance.
2. Blast furnace gas is used to the maximum possible extent under boilers without jeopardizing the operation of other units requiring blast furnace gas, such as blast furnace stoves, etc.
3. The use of more costly fuels is scheduled and the schedule maintained automatically so as to produce lowest overall steam costs.

In order to realize these objectives, important modifications are necessary in the fuel control circuits of such boilers as compared with single fuel fired units. It is the object of this paper to outline some of these developments as they have evolved from the first successful combination fuel firing installations of twenty years ago to the highly perfected automatic combustion control systems of the present day.

OPERATING ADVANTAGES AND LIMITATIONS OF OPEN HEARTH INSTRUMENTATION

by B. B. BARGMAN, Superintendent of Fuel, Carnegie-Illinois Steel Corp., Homestead, Pa.

▲ INSTRUMENTATION and control as applied to open hearth operations have gradually been expanded during the past two decades and have advanced to a stage at which it may be worth while to review and to reconsider the advantages and limitations which are associated with existing installations.

The separate units for measurement and control are discussed from the viewpoint of their limitations and accomplishments in achieving operating control of open hearth furnaces.

The units for measuring and controlling fuel, air, atomizing steam, furnace pressure, speed of reversing the furnace, frequency of reversal, and temperature limit of roof and checker refractories are discussed with reference to their use as operating tools. Specific examples are given to illustrate the advantages that have been gained as the result of various types of control installations.

EXPERIENCES IN OXYGEN FLOW MEASUREMENT

by CHARLES W. PARSONS, Assistant to the Vice President, Republic Flow Meters Co., Chicago, Ill.

▲ THE use of oxygen in steel mills is an intensive recent development, which has been discussed in various papers presented to the AISE. The cost of oxygen makes it prudent to measure the amount being used. Meters provide the needed guide to determine the rate of oxygen flow to certain steel making operations, and furnish the records for engineering and accounting departments.

Oxygen is usually measured for at least five principal uses:

1. The amount as purchased from tank car, trailer, or local oxygen generating plants, and paid for on the basis of that meter reading.
2. The flow to the principal departments of the steel plant as the bases of distributing the cost to the department using oxygen.
3. Flow to each open hearth furnace to enrich the flame and reduce the melt-down time.
4. Flow through lances into open hearth and electrical furnace baths to speed the reduction of carbon.
5. Rate and amount of oxygen used by hot scarfing machines and various cutting and hand scarfing operations.

There are at least six general types of oxygen meters in use:

1. Displacement meters, with and without mechanical integrators.
2. Mechanical float type orifice meters with recorder, but no integrator.
3. Mechanical float type orifice meters with intermittent flow integrator, and recorder.
4. Mechanical ring balance orifice meters with intermittent integrator, and recorder.
5. Electric ring balance orifice meter with remote reading instruments, including recorder and watt-hour type continuous integrator.
6. Pneumatic-electrical orifice meter with oxygen confined to sylphon sealed pneumatic transmitter, with all electric transmissions to remote indicator, recorder and watt-hour type continuous integrator for accurately totalizing sudden large changes in rate of flow.

Two problems are emphasized in these operating experiences: The explosion hazard when permitting oxygen to come in contact wth grease in a meter stuffing box and the implication that stuffing boxes should be avoided in oxygen meters.

These experiences show the importance of obtaining a continuous flow integration in order to catch the sudden large changes of oxygen flow, which occur in

most uses of oxygen. This is vividly shown on oxygen lines to hot scarfing machines and to hand scarfing, scrap cutting, hand lancing, and similar operations where the oxygen flow changes quickly.

The illustrations in the paper of meter installations in several mills show the appearances of several types of meters and approved practice of piping to the meter bodies and connections to instruments, which are located conveniently for the first helper. Charts included in paper show the difficult conditions under which many oxygen meters operate, including the wide and sudden variations in the flow.

Photographs, supplemented by engineering data show one unusually complete installation of meters at the point where oxygen is purchased by one steel mill. Here six parallel lines are each equipped with a meter having a recorder and continuous integrator, automatically compensated for any changes in oxygen pressure. Shut-off valves, automatically operated by flow controllers, sequentially place in service only the number of meters necessary to maintain the oxygen flow through each meter, in the most accurate range of that meter. Various diagrams and photographs of several of the meters are included illustrating design, operating and maintenance features of each.

DESIGN AND MAINTENANCE OF CRANE RUNWAYS

by V. L. SMITH, Assistant to Chief Engineer, Fort Pitt Bridge Works, Canonsburg, Pa.

▲ STEEL plants use practically every type of crane that operates on a runway. The operation of the cranes varies from 1 to 100 per cent of the working hours of the plant. Trolley speed and crane speed vary greatly. Some loads must be handled carefully, while rough treatment is customary for others. The allowable working stress of the runway should be varied to suit the use of the crane. Side thrust is a definite force and the runway must be designed to resist it. Soaking pit cranes seem to set up an excessive vibration in the building. Should this be considered in the design?

There is much variation in actual column design. Technical writers seem to have avoided the typical mill building column. Using current theory, the column may vary from a design that seems dangerously light to one that is unnecessarily heavy. The writer has developed a column design theory of his own which seems rational and has proven satisfactory in several installations. This theory is presented in the paper.

Review of a number of runways in need of repair has indicated the points to be carefully considered in design and detail. Most complaints are caused by loose rivets in the connection of crane girders to columns, both in the seat and diaphragm. Crane girders having knee braces are more subject to loose connections than when knee braces are omitted. Girders riveted directly to the face of the columns with the rivets carrying the full vertical shear rarely develop loose rivets.

Columns are often badly battered due to swinging loads striking relatively thin unprotected edges of their constituent metal. Settlement of columns is a major source of trouble. This is sometimes traceable to eccentric loading of the foundations. Lateral deflection of columns due to an inadequate upper shaft can cause excessive wear on crane wheel flanges and bearings.

RECENT DEVELOPMENTS IN THE DESIGN AND CONSTRUCTION OF COAL AND ORE BRIDGES

by B. A. ROSE, Director of Engineering, Heyl and Patterson, Inc., Pittsburgh, Pa.

▲ PERFORMANCE and maintenance are of paramount importance to the operator of such equipment, and the paper describes recent developments that improve the life and simplify the maintenance.

The two-motor hoist, built with separately mounted drums and driven through totally enclosed gear units with the gears and bearings flooded with oil, is the preferred hoist arrangement. Where the bucket should be turned to facilitate unloading from the hold of a ship, a turntable type hoist is the ideal solution. A compact design of two-motor hoist mounted on a turntable on the trolley frame has been developed. It allows good access to all drums and gearing and can be easily dismantled for replacement of any parts.

The generally accepted cradle drive for trolley motion has several disadvantages which are not easily avoided and a new type of construction which accomplishes the desired result of good tooth alinement has been developed. It provides more accurate tooth alinement, has fewer parts, and is lighter in construction.

The emergency stopping of the trolley at the end of the runway is a critical one. Hydraulic buffers have a certain appeal because of their ability to absorb high energies, but even they are extremely costly and complicated when designed for stopping a trolley from full speeds approaching 1200 fpm. It is believed that a more simple device that will tolerate neglect, combined with automatic slowdown and final stop controls, will give more foolproof operation. A friction type buffer utilizing railway draft gears is described.

Worm drives are becoming the standard type for bridge travel motions; a design is shown which is presently being built for a 17-ton bridge having 16 wheels under each corner. The sixteen wheels are driven from one motor through four worm type reducers to spur gear final reductions. The design is so arranged that any reducer can be removed for repair with the minimum of outage time.

Variable voltage control has been applied to one installation of ore unloading equipment and is presently being quoted on a bridge job. This type of control has distinct advantages over the rheostatic type in the power savings obtained, as well as in the simplification of the control itself and the maintenance. The power savings, as well as cost savings, are appreciable where a bridge is to be installed on a long runway and the con-

version equipment does not already exist and can be purchased as part of the variable voltage equipment to be mounted directly on the bridge structure.

SLIDING CONTACTS FOR TRANSFER OF ELECTRICAL ENERGY FOR INDUSTRIAL SYSTEMS

by H. YALE MAGEOCH, Chief Engineer, Electric Service Manufacturing Co., Philadelphia, Pa.

▲ BASICALLY the paper covers conductor systems of various types employed for the operation of steel mill equipment. Systems employing wire, solid bar, structural shapes and ASCE rails are considered.

In connection with the various type conductors, collectors of numerous types including those employing carbon contact members are discussed. These collectors as well as the conductors will be analyzed with respect to their ability to meet various operating conditions involving misalinement, contraction and expansion and normal variation with respect to horizontal as well as vertical movement required for the function of the equipment.

The paper covers the use of suitable insulators for both rail and collector use and touches on the subject of composition insulators of the phenolic type.

Comments are made concerning a few special systems which may be of value where unusual problems requiring extreme safety or where trucking across runways preclude the use of conductors installed in such a manner that a barrier is formed. The use of a-c and d-c operating voltages as well as the use of booster conductors for both systems are covered. Methods of installing boosters for a-c systems to improve regulation are pointed out as well as the difference between the application of boosters for a-c and d-c circuits. The location of feeder taps and the method of attaching are discussed.

CONTINUOUS MERCHANT MILLS

by L. C. SOWELL, Superintendent Blooming and Rolling Mills, Jones and Laughlin Steel Corp., Aliquippa, Pa.

▲ THIS paper covers in general a discussion of straight away continuous mills, and specifically the 14 in. merchant mill at the Jones & Laughlin Steel Corporation's Aliquippa Works. This mill was the first of its type ever erected in this country. The paper discusses some of the major maintenance and operating problems peculiar to this mill, which has many unique features which no doubt will be interesting to many rolling mill operators.

PASS DESIGN OF ANGULAR SECTIONS

by ROSS E. BEYNON, Superintendent Roll Shop Department, Carnegie-Illinois Steel Corp., South Works, Chicago, Ill.

▲ THE paper deals with the pass design of angles, bulb angles, zee bars, and angle splice bars. The development of the bars is traced from the earliest known usage to the present time. The paper explains in some detail the various designing problems encountered in the layout of the sections, and the difficulties encountered in the rolling practice.

The paper further describes the pass guides used for angles and the necessity for having the proper type of guides.

The paper is illustrated with 40 drawings. Many of these drawings show detailed dimensions of the passes for the benefit of young students of roll design who are interested enough to draw the passes up full size for study.

HIGH-SPEED HEATING AND ITS IMPLICATIONS FOR THE STEEL INDUSTRY

by FREDERIC O. HESS, President, Selas Corp. of America, Philadelphia, Pa.

▲ THE author describes the vital operating characteristics of high speed heating applications to the following processes:

1. Annealing of stainless steel.
2. Heat treatment of carbon steel—bar stock.
3. Heat treatment of carbon steel tubing to meet alloy physicals—oil casing.
4. Reheating of seamless tubing for sizing.
5. Radiant fusion of tinplate.
6. Continuous anneal of strip steel with radiant gas panels.

The paper is supported by pictures of actual installations, as well as temperature charts and various photomicrographs. Several unexpected results are reported, and their implication into the steel industry is projected.

CONSTRUCTION AND MAINTENANCE OF OPEN HEARTH FURNACE BOTTOMS

by C. WILLIAM CONN, General Superintendent of Melting Division, Ford Motor Co., Dearborn, Mich.

▲ THE construction of an open hearth bottom is well established, and there is little change in recent years in the shape of the pan or the steel work supporting it.

Fully rammed or partially rammed bottoms have become almost universally accepted. The greatest progress in the past few years has been in the reduction of delay time on running repairs made during the tap-to-charge period of our heat cycle.

The use of air to assist in draining holes in bottom and banks has replaced the old method of using rabbles. The present use of oxygen through a ¾ or 1 in. pipe which followed the introduction of oxygen lance work for carbon reduction can, when used with discretion, be a tool to further assist the work of draining bottoms. A hole can be drained faster and cleaner with oxygen than with air or rabbles, and is done in a minimum of time.

Use of quick-setting, high MgO bottom materials has further assisted this work of getting the bottom repaired easily and quickly. Instead of rebuilding the bottom with grain magnesite or burnt dolomite shoveled into the furnaces a few inches at a time, while fuel is on, we now take fuel off the furnace as soon as hole is drained to melter's or helper's satisfaction, and fill the hole with quick-setting material which has been mixed in a concrete mixer. Holes are filled to proper level in one dose; fuel is put back on furnace and, when up to temperature and slag is running, bottom is scatter dressed with burnt dolomite, mostly to assure the proper shape or contour of the hearth.

To summarize, these two new tools—oxygen to drain holes fast and clean, and quick-setting materials to rebuild bottoms—can help us keep our furnaces in production by minimizing bottom delay time, and reduce cost of bottom maintenance.

SUPERVISORY CONTROL AND TELEMETERING AS COST REDUCTION TOOLS

by E. WYLIE HEAD, Control Corp., Minneapolis, Minn.

▲ ALTHOUGH supervisory control and telemetering are usually considered of interest only to electric utilty engineers, engineers in other industries are now considering their use. Lower operating cost and improved operating efficiency can result from their use. Lower operating costs resulting from manpower elimination can quickly pay for supervisory control and telemetering. Centralized control and supervision allow improved operating efficiency.

The logical first use of this equipment would be for the control and supervision of the electrical system of a steel mill. Centralized control under one man lowers labor cost, allows better use of power facilities, and reduces shut down expense. Other uses include control, supervision and metering of gas and water equipment. Supervisory equipment, with illuminated plant diagrams, will enable plant management to better coordinate plant operations. Economic justification of other uses will appear upon examination.

Early systems used multi-conductor control, but increasing cost with distance and number of circuits led to modern supervisory control systems. Two systems are in common use today: the impulse system and sequence system.The first uses impulse as the signal intelligence and varies the number or timing. The second uses a sequence of audio frequency tones and varies the sequence. There are various systems of telemetering in use with each system being a different approach to the problem of translating the measured quantity into a telemetering signal.

Factors to be considered in application of this equipment include: number of supervisory control and telemetering functions involved; type of remote control circuit and number of stations on one circuit; power supply; space available and preference as to enclosure; number of simultaneous telemetering readings required, and corrosive or dusty atmospheric conditions.

STATIC MAGNETIC AMPLIFIERS FOR REGULATING CIRCUITS

by H. E. LARSON, Steel Mill Division, Industrial Engineering Divisions, General Electric Co., and T. DUNNEGAN, JR., Control Systems Division, General Engineering and Consulting Laboratory, General Electric Co., Schenectady, N. Y.

▲ THE development of regulating systems, particularly since 1940, has given to the iron and steel industry automatic control of high speed rolling mill drives, processing line drives, and special equipment such as continuous electrolytic tinning lines. The regulating circuits that have been developed have been made possible by the use of improved regulating amplifiers. Electronic amplifiers, of course, have been used for systems involving low power requirements, but it is the high power amplifier such as the rotating regulator, first presented to the Association of Iron and Steel Engineers in 1940 by Mr. F. Mohler, that has been largely responsible for the deveolpment of these regulating systems.

To supplement electronic amplifiers for small power requirements, our attention turns to the static magnetic amplifier which can be adapted to regulating circuits requiring both small and moderately large amounts of power. Being a static device, it also has great practical appeal.

Because of its simplicity, static design and, in general, somewhat lower costs than either the electronic or rotating amplifier, the static magnetic amplifier promises to extend the field of application of regulating circuits heretofore considered as having doubtful economic return.

The principle of the static magnetic amplifier has been known for over 35 years. In our zeal to develop electronic and rotating amplifiers, we might justly be accused of neglecting the development of the static magnetic amplifier. During the war years, German and Swedish engineers did explore the possibilities of the static magnetic amplifier to the point where it now clamors for our attention.

Improvements in the characteristics of core steel and in the reliability of dry plate rectifiers, both of the selenium and copper oxide type, and the development

of the germanium crystal type rectifier, give us the means for building static magnetic amplifiers having characteristics suitable for many regulating systems.

It will be the purpose of this paper to describe briefly the principles of operation of the static magnetic amplifiers, relate briefly its design features, and the forms which have been built, and discuss the characteristics of the device as an amplifier with particular attention to speed of response and amplifying ability.

Many applications have already been made or are in the process of being made on equipment used by the steel industry such as:

1. Loop control for a pickling line.
2. Bus voltage regulator for a hot strip mill rectifier.
3. Tension reel regulating system for a 5-stand tandem cold strip mill winding reel.
4. Current limit control and voltage regulation of a packaged adjustable potential system.

The paper will describe the performance obtained on the above applications and will conclude with a summary of advantages and limitations of regulating systems using static magnetic amplifiers.

THE MECHANICAL RECTIFIER

by OTTO JENSEN, Manager Rectifier Division, I-T-E Circuit Breaker Co., Philadelphia, Pa.

▲ THE mechanical rectifier was originally developed in Germany by the Siemens-Shuckert Company. After the war, an investigation by the Department of Commerce of the German industry, made the German experience available to all American manufacturers, and the author's company decided to enter the rectifier field with the mechanical rectifier. At the 1948 AISE Annual Convention and Exposition in Cleveland, two mechanical rectifiers were exhibited. On February 8, 1949 an installation consisting of two 3500-amp 280 v, d-c units was placed in operation at the plant of the Buffalo Electro-Chemical Company, Buffalo, New York. These two units have so far operated satisfactorily and well within the prescribed specification. A second installation consisting of two 5000-amp, 100 v, d-c units is now being made at the Canadian Resins & Chemicals Ltd. Plant in Shawingan Falls, Quebec. The two installations will be described in the paper.

The mechanical rectifier in many respects operates like the mecury arc rectifier but metallic contacts synchronously driven are utilized for conducting instead of an electronic stream. The ohmic drop of the metallic contacts is insignificant compared with the arc drop of the mercury arc rectifier, resulting in very high efficiency, particularly in the d-c voltage range from 50 to 400 volts. The mechanical rectifier is available in 6 sizes from 200 to 10,000 amp in the above mentioned voltage range. It can be used whenever conversion equipment is required.

MATERIALS HANDLING IN STEEL PLANTS

by L. RUSSEL ASTIE, Planning Engineer, Maintenance Department, Jones and Laughlin Steel Corp., Pittsburgh, Pa.

▲ MATERIALS handling starts, in a steel plant, with the construction and maintenance of production facilities; it then continues in receiving, storing and processing the materials which contribute to the production of steel. Finally, the steel is prepared and shipped in accordance to the specified handling requirements of the customer. Consequently, materials handling is one of the most vital functions in the successful operation of a steel plant.

Growth of productive capacity in the steel industry has been, and will continue to be, a series of steps in the increased mechanization of materials handling. Every improvement in materials handling has been a step toward increasing the productivity of each plant, lowering costs and the improvement of working conditions.

To perform the function of materials handling in a steel plant, perhaps a greater variety of handling methods and equipment are used than in any other industry in existence today. Much of the machinery is of a special nature and designed for each specific job. However, standard types of materials handling equipment have been re-designed and altered to fill some particular need. Also, many types of standard equipment such as fork trucks, high lift tractors, self-loading and unloading truck unit, pallets, containers, and various types of fixed and portable conveyors are used as purchased from manufacturers who supply other industries as well.

Studies by various divisions of the steel industry have shown that materials handling in a steel plant generally accounts for better than ⅓ of the production cost of steel. Materials handling also accounts for better than 80 per cent of all plant labor, and safety engineers report that better than 70 per cent of all personal injuries in a steel plant are a result of some phase of materials handling.

Since materials handling is so finely interwoven in every phase of steel plant operations, it is reasonable to expect that any constructive improvements or mechanization of materials handling will be directly reflected in more uniform production, reduce worker fatigue, lower costs, better safety experience and improved housekeeping.

In steel plants, we have grown accustomed to big problems, big projects, and large figures; but, we must not lose sight of the fact that little savings and small improvements can add up to be a big savings and a big overall improvement in volume of production. Chiefly by force of necessity, during the past ten years, many improvements in materials handling methods have been made in steel plants which have been of material aid in helping to maintain maximum production over a period of years when steel was critically needed. These improvements also helped to hold the line against constantly rising price levels and lowered labor efficiency after the war.

The aim of this paper is to review the general problem of materials handling in a steel plant and also some of the specific improvements which have been made during the past ten years. It is hoped that this refreshed viewpoint will spur all of us toward further achievements in improved methods by a more organized and systematic approach to the materials handling problem such as we understand is being done by many of the mass production industries of this country.

STEEL PLANT MAINTENANCE

by S. D. BAUMER, Manager, Technical Sales Division, Air Reduction Sales Co., New York, N. Y.

▲ THERE can be very little doubt in the mind of anyone connected with the steel industry that plant maintenance is of prime importance to a smooth running, top producing steel mill. To the casual observer taking a tour through a rolling mill, open hearth plant, or blast furnace department, little or nothing is known of the work done behind the scenes to present to him this picture of uninterrupted production.

There is nothing glamorous about this maintenance and repair work that goes on behind the scenes of these various units, but it is here that maintenance crews are busily engaged in combating all kinds of destructive forces, such as erosion, heat, shock, etc.

That the mills keep rolling, that the furnaces continue to make on-grade steel and iron at a reasonable cost is due largely to modern efficient maintenance methods.

Such modern methods are based on three important fundamentals:

1. Effective planning and organization of plant personnel and facilities.
2. Effective and economical use of the most modern tools and processes.
3. Work properly engineered from the safety standpoint.

These three fundamentals are strongly interdependent and their implementation depends largely on the operations involved, their number, size and nature. While these details may vary, certain general considerations, common only to the steel industry, are the real basis for effective maintenance. These considerations are:

1. Steel mill equipment works at high production levels, often continuously, on closely integrated schedules.
2. Equipment is heavy, massive, yet subject to such wear that maintenance is a repetitive, demanding job.
3. Relation of costs to profits is such that every operation, maintenance included, must be economically justifiable—efficient and reliable.
4. Changing, modifying, and improving equipment is a constant challenge in steel plant operations.

To this end, the oxyacetylene welding and cutting industry, with its allied products for electric welding, continues to bring out new tools and processes which are of vital importance to the speed and efficiency and safety of the modern maintenance department.

RELATIONSHIP OF MATERIALS HANDLING TO PRODUCTION

by JAMES S. FREESE, Production Manager, and FRANK C. WIER, Superintendent of Materials Handling, Steel and Tube Division, The Timken Roller Bearing Co., Canton, Ohio

▲ NEW methods of production control of finishing operations and the material handling system necessary to furnish the flexibility required to implement this control, have been introduced into Steel and Tube Division of the Timken Roller Bearing Company, Canton, Ohio. Production scheduling and fluid movement of materials are definitely complementary to each other, and a full measure of success for either one will not be realized without the other.

It has been found that through the new methods which have been introduced, the percentage of orders shipped complete and on time has been greatly increased. Machine production likewise has shown improvement. Scrap loss and waste have been reduced, and the general efficiency of the finishing operations has been favorably affected.

Operating space in the finishing department buildings has been made available by the utilization of outside yard areas for the stocking of in-process steel. The control of the physical movement of material by straddle truck method has been improved and speeded up by the introduction of a two-way radio dispatching system. Material congestion in the operating buildings has been eliminated.

The various functions of the two new systems present new problems and require a different approach to their solution.

THE ACTION OF CUTTING FLUIDS IN MACHINING

by M. EUGENE MERCHANT, Senior Research Physicist, The Cincinnati Milling Machine Co., Cincinnati, Ohio

▲ IN practice a cutting fluid is called upon to perform many functions. However, in every cutting fluid application there are two basic actions which a cutting fluid must perform well if it is to be effective. These are:

1. To carry away the heat generated in cutting.
2. To reduce the friction between the flowing chip and the cutting tool.

When these actions take place effectively, the result is longer tool life, better surface finish and lower power consumption and tool forces in machining. This paper

is concerned with these two basic actions, with particular emphasis on the second.

A number of variables control the ability of a cutting fluid to carry away heat. For instance, the specific heat, heat conductivity, rate of flow, amount of oil content in a soluble oil mix, etc., all play important parts. Such cooling directly affects the tool life but has almost no effect on surface finish or power consumption and tool forces.

The factors important to the second basic action of a cutting fluid—that of reducing the friction between chip and tool—have not been as well understood until recently. The understanding of this action has come out of basic research on the metal cutting process itself. This has shown that heat is generated in the cutting process from two different sources—the friction between chip and tool and the deformation of the metal ahead of the tool. However, a still more important finding is that the application of an effective cutting fluid is able to reduce not only the heat coming from rubbing friction between the chip and tool but also that coming from the deformation of the metal. This is because the amount of deformation of the metal is dependent on the friction between chip and tool. In addition, the reduction in chip friction brought about by use of an effective cutting fluid improves surface finish and reduces power consumption and tool forces.

How is a cutting fluid able to reduce friction between chip and tool? It does so by a chemical action. To be effective in this respect a cutting fluid must contain additives carefully chosen for their chemical properties. These react with the chip metal at the chip-tool interface to form, as a reaction product, a protective film which reduces or prevents metal-to-metal contact at this point. Thus the chemical re-actions occurring at the chip-tool interface are they key to effective friction reduction.

STEEL PLANT LUBRICATION TRAINING

by WILLIAM M. SCHUCK, Lubrication Engineer, Armco Steel Corp., Middletown, Ohio

▲ THIS paper is a discussion of the necessity of providing an adequate lubrication training course for all personnel of the average steel mill who are connected either directly or indirectly with the duties of oiling and greasing steel mill equipment. This problem, posed by equipment of old and new design with the many methods and types of lubricating devices resulting from equipment diversity, is considered together with the effect this condition has upon the need for adequate training. What effect the use of partially trained personnel has upon the problem of adequate lubrication is also discussed. A general lubrication program or policy is advanced as one method of eliminating these difficulties and the program is described in detail and in sequence of importance. Within the framework of this policy, the phase of correct and adequate lubrication training is considered to be of the greatest importance. The methods used to effect this type of training by the author's company are discussed and includes the type and groups of personnel trained, the mechanics of class procedures; the scope of training and an outline of the text material used.

AN EVALUATION OF OIL PURIFIERS FOR STEEL MILL SERVICE

by JAMES I. CLOWER, Chairman, Department of Mechanical Engineering, University of Delaware, Newark, Del.

▲ THE perfect lubricating oil would retain in service its original physical and chemical properties for an infinite period of time regardless of the design and operating conditions of the system. Such an oil would accomplish its purposes—lubrication and cooling—cause no trouble, and last forever. Moreover, it would be extremely helpful if this perfect oil would also reject from the system any and all foreign material and refuse to leak from the system under all circumstances.

Although great strides have been made in recent years in improving the stability of lubrication oils and in the design of oil systems, nevertheless, present day oils do undergo in service many and various complex chemical and physical changes. The changes that occur in oils in service are alleged to be caused chiefly by oxidation and, to a somewhat lesser extent, by thermal decomposition, polymerization and condensation. Oil deterioration is a complex phenomenon, the kinetics of which are far from being well understood. At various times and stages of oil deterioration there may be found in the oil, organic acids, volatile carbonyl compounds and saponifiable materials. All of these chemical changes are greatly accelerated by the presence of external contaminants, such as metallic particles, rust, water, etc., which act as catalysts.

Collectively these products, including foreign matter, are commonly referred to as sludge, the character of which, of course, varies widely depending on the properties of the original oil, the nature and amount of foreign impurities present and the time, pressure and temperature conditions to which the oil is exposed. Sludge is definitely harmful as it tends to clog oil lines and passages, increase operating temperatures, cause sluggish operation of the equipment, and impairs the lubricating properties of the oil.

Any devices that will remove completely or partially sludge from a lubrication oil system is definitely desirable from a lubricating standpoint and is generally an economical asset.

In addition to oil deterioration and sludge formation, the fundamental principles of purification and the basic principles upon which oil purifiers operate are discussed in this paper. Commercially available purifiers suitable for steel mill service are illustrated and their

principles of operation are explained. Criteria for judging purifier performance are given, and operating procedures for obtaining optimum performance are discussed. Methods of evaluating performance characteristics are also presented.

INCREASED OPEN HEARTH PRODUCTION BY IMPROVED CHARGING METHODS

by RUDOLPH TIETIG, JR., A. J. Boynton Co., Chicago, Ill.

▲ THE scope of this paper is limited to consideration of the charging procedure as carried out in the majority of plants in this country and includes various suggestions by which the present procedures might be improved. No consideration is given to any radical departure from existing methods. Present procedures are analyzed and the various factors that govern the charging operation in a plant are appraised. These factors include the following:

1. Track layout.
2. Scrap preparation facilities.
3. Charging boxes and cars.
4. Cranes and charging machines.
5. Furnace charging doors.
6. Hot metal ladles.
7. Hot metal storage facilities.
8. Locomotives.
9. Building and crane runways.

Each of these items are discussed and various alterations and additions suggested that may reduce their limiting effects. Where possible, methods of evaluating the alterations and additions, with respect to an increase in ingot production, are outlined. Numerous illustrations are included.

RELATIONSHIP OF PREVENTIVE MAINTENANCE AND ROLLER BEARING APPLICATION

by JOHN A. TOTH, Chief Engineer, The Torrington Co., Bantam Bearings Division, South Bend, Ind.

▲ THE author discusses preventive maintenance of roller bearings in relation to their design, application and operation in steel mills.

Preventive maintenance is defined as the control of such variables affecting bearing life as load, speed, shock loading, temperature, lubrication and sealing; and the elimination, so far as is possible, of such variables as inaccuracies in components of bearing assemblies, misalinement in mounting, contamination and operating abnormalities.

Maintaining high standards of bearing performance is seen as the joint responsibility of the bearing manufacturer, equipment builder and mill operator. Contributions of the bearing manufacturers in improved design, use of better materials and heat treating methods are discussed. Variables affecting bearing life expectancy are discussed in their relation to procedures of mounting, operating and servicing roll neck bearings.

Preventive measures in handling and mounting roller bearings include: protection from contamination; concentric and square spacers, adapter rings and locknuts; holding roll neck diameters uniform and concentric to roll body; holding shoulders, bearing contact surfaces and grooves square with roll axis; alinement of chocks in mill housings, vertically and horizontally; mounting offset and crowned rolls to prevent excessive thrust loads.

Inner race creep is discussed and measures to prevent neck scoring are detailed, and preventive measures related to bearings race rotation and bearing inspection and interchanging are also discussed.

The author emphasizes the importance of true accurate and significant service life records in any effective preventive maintenance system. Despite the controversial nature of tonnage records, the author maintains that a good picture of bearing performance can be secured with records containing proper information. The requirements of such records are discussed. Only an adequate history of performance of bearings will provide a basis for effective preventive maintenance. The functions of lubricants and their part in securing maximum life expectancy are discussed, together with the selection and application of oil and grease seals.

CONSIDERATIONS IN THE DEVELOPMENT OF ROLL NECK OIL SEALS

by E. W. FISHER, Service Department, The Garlock Packing Co., Palmyra, N. Y.

▲ RECENT advances in rolling steel have put a premium on bearing performance requiring strictest attention to lubrication and maintenance of the system through the use of oil seals. In order to keep pace with the greater demands on oil seals, research has revealed much about the way an oil seal works, thus leading to many improvements.

In final analysis an oil seal is in reality a bearing. It is a unique bearing in that it is uniformly loaded about its entire circumference. However, as a bearing it is affected in similar manner as any other bearing by variations in lubricant, quantity of lubricant, shaft movements and shaft finishes. High speeds tend to raise bearing temperatures. In an oil seal, high temperatures tend to greatly reduce the seal life. This effect of heat receives considerable attention in seal design and choice of materials.

The design of a seal may be anything from a heavy rugged section carrying a heavy spring load to a very light flexible section with a correspondingly light spring, the latter finding particular preference on high

speed mills. Materials used in the sealing members run from leather through rubber and synthetic rubber compounds. Springs may be the finger or coil type, each having its own advantages.

Proper stocking and general care in handling and installation are prerequisites on the user's part for satisfactory service.

The study of oil seal leakage and attempts to fit the laws of fluid flow to it have failed. The study yields much empirical data which does not lend itself to a mathematical basis of seal design. Experience gained from laboratory and field operations alone is the one valuable guide in design.

Although the popular seal today is the flange or lip type shaft seal, there are also so-called face or rotary type seals. These latter units require quite special attention and, due to their size, the degree of accuracy required and the complexities of manufacture and servicing, are rather costly. They are yet to be proven. There are also the piston ring type seals which function well as pressure breakers although leakage may be somewhat high. The forecast is made for further improvements through the use of silicone rubbers.

BEARING INSPECTION AND REPAIR

by C. T. LEWIS, Lubrication Engineer, Republic Steel Corp., Warren, Ohio

▲ BEARING inspection and bearing repair go together throughout the entire life of a given bearing. Inspection of a bearing, if not followed by such repair as is indicated by the inspection, is a total waste of time and effort. Consequently, both the inspection and the repair should be considered as a unit and carried out together.

The basic requirement for bearing inspection and repair is the proper area and attendant facilities for not only making the inspection but to be able to do the various operations needed for the repair and fitting-up of the repaired bearing.

Numerous repairs can be made on the tapered-roller type of anti-friction bearings and on most of the oil-type friction bearings, while mechanical difficulties and lower economical returns may prohibit satisfactory repair of ball and other types of roller bearings.

Repairs on tapered-roller bearings may include the grinding out of objectionable spall spots on cups, cones, or rollers and/or the substitution of individual rollers, cups, or cones in a given bearing.

Repairs on oil-type bearings may include the rebabitting of the bearing surface, the repair of the surfaces on which sealing members may ride and the return of the outside diameter of the larger type oil-bearing bushings to true concentric original dimensions.

Complete records on each bearing should be kept as a combined effort of both the bearing shop foreman and the mechanical foreman of the department in which the bearing is used.

The individual bearing record should include dates of installation, use, and repair; along with the service tonnages and notes as to the inspection and repair history.

Inspection periods must be determined by the type of service and normal tonnage life expectancy. The inspection period should be of short enough time as to make repairs possible rather than to allow a bearing to completely wreck itself.

Bearing repair makes it possible to obtain monetary savings by being able to obtain up to fifty per cent additional life from the bearing.

CONTROLLED COOLING OF STEEL BLOOMS IN CAR BOTTOM FURNACES

by C. J. F. BURCH, Supervisor Design, Open Hearth and Electric Furnaces, Carnegie-Illinois Steel Corp., Duquesne Works, Duquesne, Pa.

▲ THE controlled cooling of high carbon and alloy steel blooms for the prevention of flaking not only gives positive and uniform results but is four times faster than slow cooling. As an answer to the problem of furnace loading and unloading within process time limits, a handling method to be used for controlled cooling in car bottom furnace is proposed which will load the blooms on the furnace car in spaced layers as rapidly as the blooms are rolled. A 100 ton load may thus be assembled as it comes off the mill and be ready to be charged into the furnace before the temperature of any of the blooms falls below 600 F.

MATERIALS HANDLING IN STEEL PLANTS

by L. O. MILLARD, Assistant General Sales Manager, Link-Belt Company, Chicago, Ill.

▲ THE paper presents a discussion of functional requirements as well as the importance of conveyors in obtaining the maximum utilization of mill facilities, and the necessity for handling large heavy coils without damage to obtain maximum yield. The construction of the latest and the most successful types of conveyors are covered as well as their fields of application and limitations. Since most damage occurs as the coils are transferred from one unit to another, much of the paper is devoted to recent developments in loaders, special transfer mechanisms and unloaders designed to handle the coils gently.

Supplementing the paper is a 16mm kodachrome film which covers the conveyor system in the J & L Aliquippa pickle line as well as the conveyors serving the new No. 3 Temper Pass Mill at Irvin Works. In addition, the film illustrates both with animation and live shots conveyor installations at Gary Sheet & Tin Works, Geneva Steel, and J & L's Otis Plant. Over half of the picture is devoted to coil handling.

BUFFALO MAINTENANCE SYMPOSIUM - 1948

TRAINING OF MAINTENANCE PERSONNEL

by D. W. McLEAN
Assistant General Master Mechanic
Steel Co. of Canada, Ltd.
Hamilton, Ontario, Canada

▲ THIS subject might well have been titled "Training of Personnel" for basically there is no difference between production and maintenance personnel. They are all human and require handling as humans.

In industrial work there are several requirements which all good employees should possess; one, a knowledge of their job, that is the actual performance, which lever to push, which rope to pull, etc.; second, he must know the hazards of his job, how his work might endanger others nearby, and how their work might endanger him; third, he must have the ability to get along with fellow workers.

If I may digress for a moment, a statement made at a recent dinner comes to mind. The speaker said, "The key to success in any organization is unity, by this I mean each individual trained to do his particular job and doing it." That is what training is, knowing how and doing.

In any type of work, the first requirement, knowledge of the job, may be achieved by a set pattern of training, which has proven successful. Here we all, I think, adopt the same method to some degree, consciously or otherwise. First we explain the job, then we demonstrate the job and lastly correct the worker on the job. This method, we all know, will acquaint the employee with the actual mechanics of the work. These steps may extend over a long or a short period. In maintenance work they are often over a long period and must be repeated frequently, due to variations which are encountered in jobs. No two maintenance jobs are identical.

The second requirement, safety, is not so well patterned from a training standpoint. Many approaches have been tried on this phase of employee training. As for our experience, I would say we are still experimenting, trying to find some method of reducing accidents. In maintenance work where known and often incorrectable hazards exist the problem is acute. Safety consciousness must be obtained in this type of work.

The third "must," the ability to get along with his fellow workers, is equally important with the other two. The first two depend upon training. This one depends more upon the individual and is little affected by training. The perpetual grouch, the loafer, the agitator are familiar to all of us and are not good employees. Leadership, guidance and a good example may bring out whatever ability the employee possesses in this respect.

This brings me to the question of supervisors, their selection and training. In my humble opinion this is the keynote of any training program. Good supervisors make for good employees. No effort, no amount of time spent in selecting leaders is too great. Our method has been to constantly observe all our employees, discuss each employee with his immediate supervisor, and keep records of employees' progress. Some of the essential requirements we look for are, initiative, industry, honesty, knowledge, ability, tact and safety consciousness. Whenever a supervisory position is to be filled, all employees capable of filling the job are listed. The merits of each individual are discussed and the best man for the particular job is selected.

A course of foremanship training has been completed at our plant. This was undertaken with a view to improving the present foremen. The benefits of this program have been fairly satisfactory. With the trend of labor relations we all now face, good foremanship is essential. Much dissatisfaction and many grievances can be corrected by an alert foreman and conversely, much dissatisfaction can be caused by a poor foreman.

Presented before AISE Buffalo District Section Meeting, February 10, 1948

DISCUSSION

PRESENTED BY

R. W. GRAHAM, Electrical Superintendent, Bethlehem Steel Co., Lackawanna, N. Y.

D. W. McLEAN, Assistant General Master Mechanic, Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada

M. A. LEISHMAN, Electrical Superintendent, Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada

R. W. Graham: Mr. McLean, what is the method you use in training crane operators?

D. W. McLean: The crane operators do not come under the jurisdicton of the mechanical department. Recently they were transferred to the production divison of the section in which they are working. Previous to this, the crane operators came under the jurisdiction of Mr. M. A. Leishman, who is present tonight, and who may wish to comment on the question.

M. A. Leishman: The training of crane operators has always been a difficult job. The majority of accidents in our plant involves crane operators. Our training program helps us to educate cranemen not only to handle their cranes safely, but also to take the responsibility for the safety of others.

A good sense of humor is necessary in a craneman.

He is often blamed by fellow employees for things happening on the floor in which he played no part and this should not anger him. An angry craneman is a hazard.

We also have rigid physical tests with special emphasis on good eyesight and on ability to judge depth.

R. W. Graham: Apparently there are differences in interpretation of any contract with the union. Our seniority is based on the following: years service, physical fitness, and ability to do the work. Under this definition of seniority, we are able to make a somewhat better selection of our foremen.

PLANT MAINTENANCE -- GENERAL

by G. E. KAMERER
Superintendent, Electrical Div.
Colorado Fuel and Iron Corp.
Buffalo, N. Y.

▲WE, in the iron and steel industry are well acquainted with the everyday problems of keeping the mill running under many adverse conditions. The problems that arise on a breakdown are many and often complex. The top management is not interested at the particular moment in how repairs are made, but are vitally interested in seeing that repairs are made immediately and the mill put back into production. There are many tricks of the trade that we resort to from time to time to make patch-work repairs and keep the mill running, awaiting a regular shutdown period to go back and make the repair a permanent and satisfactory one. Rather than dealing with the problems of individual repairs and maintenance that occur in our everyday activities, I believe that it is more to the interest of the entire group this evening, to discuss ways and means of preventing these costly shutdowns by preventive maintenance. As the superintendent of maintenance is responsible for both the mechanical and electrical equipment within his plant, it is necessary that he has under his jurisdiction sufficient trained personnel to take over the responsibilities of the details of the mechanical as a separate group and the electrical as a separate group. Under this supervision must come the competent and trained men, such as mill mechanics, welders, erectors, riggers, electricians.

One group of men who are often overlooked, but are very necessary in the smooth working of an organization, are those who are sometimes called machinery inspectors or motor inspectors, depending on their specific duties. It is the function of this group of men to make regular and periodical inspections of all the equipment within the plant to try to observe possible conditions that will result in trouble later and to recommend a method of correction or reporting direct to the foreman responsible for that section of the mill and its maintenance.

A detailed plan of operations must be set up for all equipment that is indexed and carried on some type of card record. This record should indicate the name of the equipment, the manufacturer of the equipment, the manufacturer's type number, serial number and other pertinent data to enable the mill to obtain the necessary replacement parts when required. In addition to the above data, certain schedules should be placed on this card as to the operating record, lubrication schedule, inspection schedule, all breakdowns, cost of repairs and time in manhours on the repairs. It is only by such a record that the maintenance department can approach the management for a replacement of equipment, when it can be shown that the cost of maintenance on this particular piece of equipment is beyond that reasonably encountered in mill operation.

The motor inspector should be trained, so that in addition to inspecting the rotating equipment, and control equipment together with the feeders, he is qualified to check the associated control equipment and to make minor repairs and adjustments during his regular inspection cycle. It would be further advantageous if this motor inspector were qualified to follow through and inspect all shafts, bearings and foundation bolts, satisfying himself that the equipment was mechanically, as well as electrically suitable for operation. Having established this record and inspection program, it has been found that many conditions which would lead to a serious breakdown if not taken care of immediately, can be corrected on a plant maintenance schedule when the mill is scheduled to be down. This avoids many of the breakdowns which occur in the mill, and which in themselves put the maintenance department behind all the pressure of the front office, because of the tonnage loss.

We are all aware of the fact that a much better job is done in replacing and repairing any piece of equipment when we are not under the pressure of the management to get the equipment back into operation as soon as possible. In addition, it is possible to avoid the overtime rate that must be paid when you are compelled to work around the clock to repair an emergency breakdown.

It is our opinion that if more preventive maintenance be practiced, we would be able to obtain better results at lower cost in the overall picture, making it possible to schedule repairs and avoid possible breakdowns which occur all too often.

DISCUSSION

PRESENTED BY
H. B. STALLINGS, District Manager, Clark Controller, Buffalo, N. Y.
G. E. KAMERER, Superintendent Electrical Div., Colorado Fuel and Iron Corp., Buffalo, N. Y.

H. B. Stallings: Mr. Kamerer, how successful are you in obtaining satisfactory results from your inspection department on making adjustments on controls, and how does this type of maintenance eliminate outages?

G. E. Kamerer: We have not been too successful, due to friction existing between the maintenance and the inspection men. The maintenance department feels that this type of work comes under their jurisdiction and that the inspector should only report any difficulties he may see.

HARD SURFACING IN MECHANICAL MAINTENANCE

by R. F. FALLON
Master Mechanic, Blast Furnaces
Bethlehem Steel Co.
Lackawanna, N. Y.

▲ WHEN a maintenance man becomes aware that, due to abrasion, some particular part of his equipment regularly wears out more rapidly than the balance, he endeavors to correct the condition. In the past he has been limited to replacement of the part with heavier sections or better material, changing details to reduce the abrasion or confine it to small easily replaced parts or covering the affected surface with wear plates. In many cases none of these expedients were satisfactory.

The introduction of hard surfacing some twenty years ago provided an additional method. Welding an abrasion resisting alloy directly to the wearing part can correct the trouble at the source. These alloys are many and are available for application with the electric arc or the acetylene torch.

The uses throughout the steel industry are numerous. Shear blades, guides and pinch rolls, valves and valve seats, pug mill blades, grizzly bars, crane tong bits, and tap hole drills represent only a few of the successful applications.

In the blast furnaces we have found many uses of hard surfacing. Every ton of iron produced means the handling of over three tons of abrasive raw materials and two-thirds of this is handled several times. Maintaining the equipment handling this material has proved the value of hard surfacing to us.

Ore and limestone are unloaded from boats into the ore yard by three unloaders. The buckets of these unloaders consist of a cast manganese steel bottom and rolled steel side plates. Wear on the cutting edge of the soft side plates used to result in considerable spillage after a short time. Hard facing has made these plates last as long as the hard bottoms. This hard facing is renewed during the operating season as required on days when no boats are being unloaded. No attempt is made to hard face the manganese bottoms since they give satisfactory wear for a complete unloading season.

Three ore bridges stock the ore and stone back in the ore yard as it is unloaded and hoist them from the yard to transfer cars. One of these bridges handles as much as 6000 tons of material per day. When these bridges first operated, the bucket lips wore out in six months and the bucket shells in a year. Replacement of the lips entailed an 8 to 10 hour job by six men; replacement of the shells required shop repair regardless of the condition of the balance of the bucket. By coating the lips and the front of the shells with self hardening electrodes, the life of these parts has been extended. Hard facing takes 48 hours and requires 200 lb of rods. By use of a spare each bucket can be resurfaced as necessary and the life of the lips and shells now equals or exceeds that of shafts, bushings, arms and other mechanical parts.

Both bridge and unloader buckets are hard surfaced by electric welding. This method is used because the size and weight of the buckets and their location in the ore yard prevent the preheating necessary for acetylene application.

The transfer cars, which carry the ores to the various furnaces, the ore chutes, the skip car to the furnace top and the hopper on top of the furnace are protected with manganese steel wear plates. In many cases replacement of these plates became necessary because the bolts holding them in place proved to be weak points where failure started. Often complete wearing away of bolt heads resulted in loss of plates. Coating the heads of these bolts with hard rods has prevented premature failure of the wearing plates. The usual procedure is to hard surface the head after the plate is bolted in place. When the job will cause a delay to operations, bolt heads are surfaced preparatory to doing the job, thus saving a part of the delay.

At the furnace top, the skip cars dump through the hopper onto the small bell. This casting is subject to the most severe abrasion only on the top 18 in. of its 6 ft height. By surfacing this 18 in., the life of the bell can be increased 50 per cent. Due to operating conditions, it is seldom possible to renew the surfacing on these bells.

In 1943 the ends of the rails on the ore trestle became so badly battered that repair could no longer be deferred. These rail ends were built up using a high carbon rod and electric arc. In this case preheating was necessary to prevent spalling of the head of the rail. Grinding after welding provided smooth joints. These rails are still in service. This rebuilding was possible without interference with operations and saved 100 tons of rails and much labor at a time when both items were critically scarce. The time required to resurface a joint varied with the amount of build-up required. A crew of 1 welder, 1 repairman and a helper repaired 3 to 4 joints per day.

Hard facing the wearing surfaces of mud gun screws and later mud gun plungers has been standard practice for several years. These parts can be rebuilt repeatedly and replacement is seldom required. Accurate grinding to size, after each rebuilding, is necessary.

With the accumulation of experience in hard surfacing and the constant improvement in the materials available, we expect to further widen the use of this method in our maintenance.

LOW VOLTAGE DISTRIBUTION SYSTEM IN A STEEL PLANT

by P. B. MANSFIELD
Electrical Power Engineer
Republic Steel Corp.
Buffalo, N. Y.

▲ MUCH study has been devoted to the design and maintenance of high voltage systems in steel plants,

but it seems that relatively little stress has been accorded to the reliability of the essential 220 or 440 volt systems. Failure of low voltage supply resulting in the stoppage of mill tables, cranes, or other auxiliaries cause production delays just as surely as failures of the high voltage serving mill-drive motors and other large units.

Preventive maintenance in steel plants may be regarded as maintenance engineering; a planned program of continuous improvements based on overall system requirements, the major objective being continuity of service with safety to personnel.

In the older methods of low voltage distribution a prevailing weakness consisted of power interruptions of considerable duration and affecting large parts of the system whenever a fault occurred. This was largely due to the common use of fused switches as disconnecting and protective devices, and may be corrected by replacing the fused switches with modern enclosed cricuit breakers. There is an important difference in the function of the two devices, although both were designed to automatically disconnect a short-circuited, grounded, or overloaded machine or line from the system as well as to provide a means of voluntary switching. The selection of fuse capacity is based on machine or line rating. We have reason to suspect that in actual practice, fuse links were often multiplied to the point where blowing was hardly possible. This, of course, defeated the purpose of the fuse as a protective device.

Even when fuses are correctly applied, a blown fuse must await the arrival of the electrician with the necessary replacements before power service may be restored.

Now let us consider the enclosed circuit breaker, a device which has been highly developed by the various manufacturers during recent years. Circuit breakers are selected on the basis of load and of system short-circuit values. Manufacturers' tables based on transformer ratings, impedance, and interrupting capacity in rms amperes relieve us of tedious calculations in specifying adequate capacities. Various types of magnetic and thermal overcurrent trips are available which may readily be adjusted to provide the desired protection. A combination of current setting and time delay may be applied to provide selective tripping throughout the system, in that way confining outages to their sources without causing interruption of service in other parts of the system. An enclosed circuit breaker which has tripped due to overload may be safely reclosed by anyone present without awaiting the electricians arrival, thereby reducing production delays to a minimum. The breaker provides the necessary protection to equipment and to personnel, has no exposed live parts, requires little maintenance, is not expensive, and yields an excellent return on the investment by increasing continuity of service to producing departments. A program of replacing fused switches with enclosed circuit breakers will go far toward improving the safety and reliability of low voltage systems.

A vital factor in maintaining power service is adequate insulation, which presents special problems in steel plants. The continual expansion of production facilities involves increased connected load each year to a point where voltage drop indicates replacement of the older feeders and branch circuits. Herein lies the opportunity of improvement by installing cable or wire employing recent developments in better types of insulation. The type should be carefully selected on the basis of surrounding conditions peculiar to each installation. In general, it is not sound economy to use type R wire on important circuits in a steel plant except under the most favorable conditions. The better grades of moisture and heat resisting rubber will prove to be sounder investment in most cases. The A.V.C. type of insulation is particularly advantageous at high temperature locations. For underground duct systems, the modern special rubber compounds with non-metallic sheath offer several advantages. All such replacements must be selected on the basis of providing adequate voltage under conditions of increasing load.

Failure of insulators on overhead lines in steel plants was at one time quite common. Experience has shown that the specifying of insulators by normal voltage rating is not suitable under the very dirty atmospheric conditions prevailing. The obvious answer is to use a type and size of insulator that will stand up under the conditions, and which will not require periodic cleaning. A porcelain dead-end insulator having a leakage distance of 5½ in. and of the fog-type construction has shown excellent performance on 230 v feeders in extremely dirty locations. The fog-type design allows a self-washing action when exposed to rain. A program of replacing old types of insulators may be set up and carried through with relatively little expense and will contribute heavily to system reliability.

The topic of low voltage distribution systems involves the vital subject of safety to personnel. Almost everyone is aware of the dangers of high voltage, but despite the frequent reports of electrocutions in the home by contact with only 110 v the hazards of burns and fatal shock from low voltage industrial circuits are not commonly appreciated. Of necessity, these circuits are often installed in locations more vulnerable to mechanical injury, oil, grease, heat, dirt, corrosive gases, steam, and water, than is the case with high voltage lines. These considerations must be given first place in the design and maintenance of low voltage distribution systems in steel plants.

DISCUSSION

PRESENTED BY

H. B. STALLINGS, District Manager, Clark Controller Co., Buffalo, N. Y.
M. A. LEISHMAN, Electrical Superintendent, Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada
P. B. MANSFIELD, Electrical Power Engineer, Republic Steel Corp., Buffalo, N. Y.

H. B. Stallings: Mr. Mansfield, what is your opinion of the combination starters, and do you prefer this starter to be located adjacent to the motor or in a panel lineup adjacent to the distribution feeders? Also, do you prefer circuit breakers in the starters in preference to fuses?

P. B. Mansfield: We prefer circuit breakers to fuses and generally we prefer the starter to be adjacent to the motor.

M. A. Leishman: Mr. Mansfield, you mentioned in your presentation that not enough attention was being given to a good grade of rubber-jacketed cable, from which statement, I presume, you have had some difficulty with lead-covered cable. Will you cover this in a little bit more detail?

P. B. Mansfield: We have had a considerable amount of trouble with lead-covered cable and have had no trouble wtih neoprene-covered cable. This latter type of cable eliminates potheads and simplifies termination. We have also experienced trouble with lead-covered cable when installed where it is subject to vibration. The lead crystallizes and eventually causes a failure.

USES OF PORTABLE RECORDING METERS

by G. H. CASWELL
Electrical Superintendent
Page-Hersey Tubes, Ltd.
Welland, Ontario, Canada

▲ THERE are a number of portable meters, but the principal ones for studying power loads are the voltmeter, the ammeter and the wattmeter.

The advantage of using a portable recording meter is that it can be taken on the job to a certain location or machine and obtain a record on a chart of a particular load. There are two types of charts, the strip and the round dial. The dial chart is usually divided into twenty-four hours, the strip chart can be divided into hours if the meter speed is constant, but is usually divided into inches and the time computed by the speed of the chart as so many inches per hour or minute. A portable meter with several different speed changes is preferable to correspond with the load changes, for example, with a load which is fairly constant, a chart speed of 2 in. per hour is sufficient, but with a load having three or four duty cycles per min-

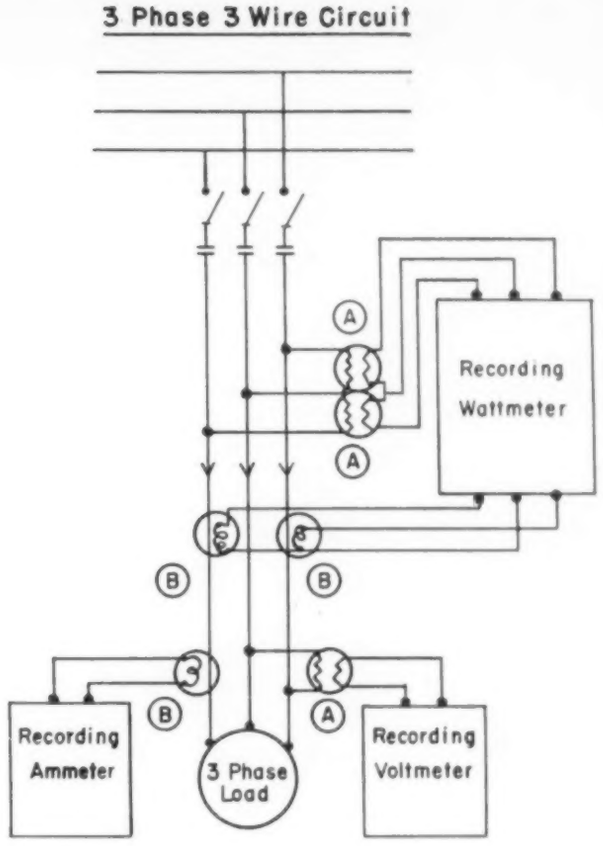
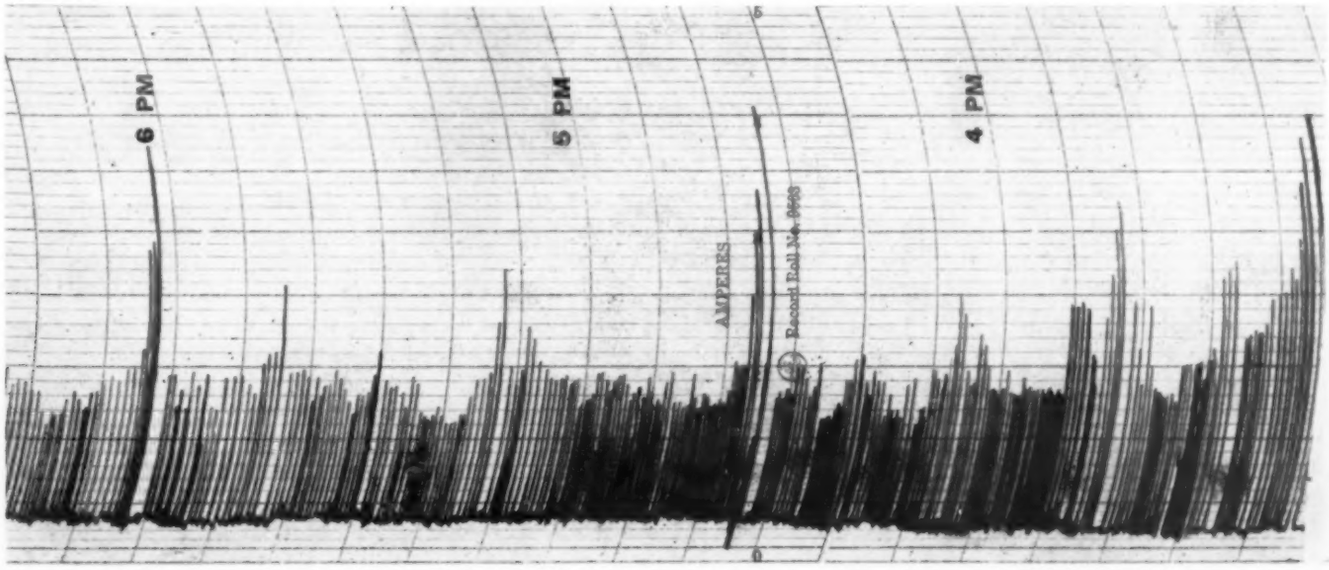


Figure 1 — The sketch shows how portable recording meters can be connected to a 3-phase, 3-wire circuit.

Figure 2 — Chart from a portable recording ammeter using a portable current transformer with a ratio of 200 to 5. Two amperes on the chart represent 80 amp, which is the full load current of a 350-hp, 2200-volt, 3-phase induction motor. High readings indicate the working of steel that has been delayed and cooled in the process line. (This is why steel mill motors should be made with ample capacity.)



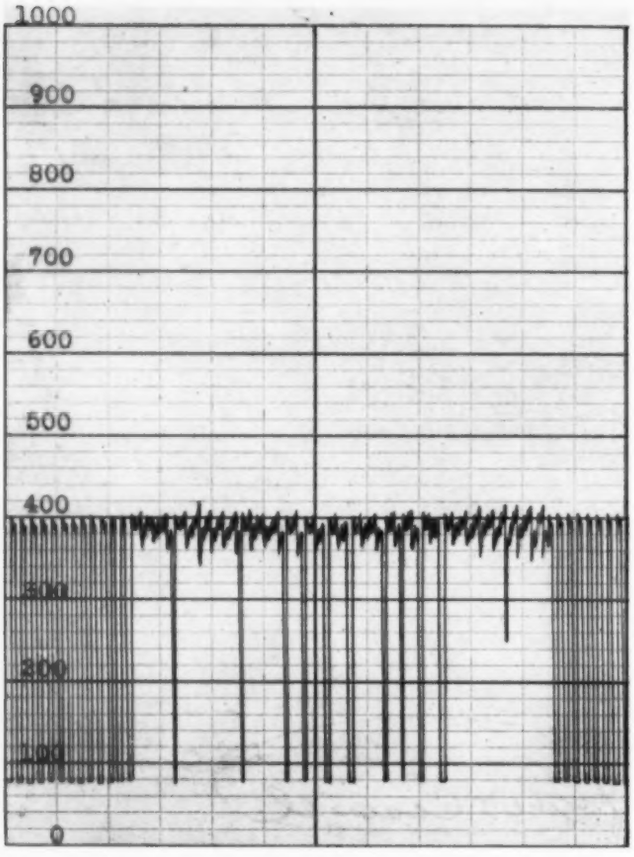


Figure 3 — Section of a chart from a portable 3-phase, 3-wire recording wattmeter, connected as shown in Figure 1, using two 200/5 current transformers and two 550/110 volt potential transformers.

The chart reading is in watts. To calculate the chart reading in kw, multiply the transformer ratio 40/1 by 5/1, which gives a multiplier of 200. By taking the highest peak of the chart reading as the maximum load, which is approximately 420, and multiplying by the above multiplier, 200, the result is

420 x 200 = 84,000 watts or 84 kw or 112.6 hp. This is the input of the motor.

To find the efficiency of the motor, use the name plate rating, which in this case was 75 hp, 550 v, 77 amp 3-phase.

$$\text{Thus } \frac{550 \times 77 \times 1.732}{746} = 98 \text{ hp input}$$

$$\frac{75}{98} = 0.765 \text{ or } 76.5 \text{ per cent efficiency}$$

Now multiply 112.6 hp by 0.765 = 86 hp using round figures, which is usually close enough for trouble shooting.

It is interesting to note the pattern of this chart. It was a 75-hp motor driving a high-pressure water, plunger pump with an accumulator to hold the pressure. When the demand was light, the pump would force the accumulator to the top and then cut off. When it dropped to a certain point, it cut in again, but the chart showed that occasionally the demand was too great for the pump, and the pressure dropped.

ute, then one would require a chart speed of 12 in. per hour, so as to get a clear mark and not a smear on the chart. Another nice feature is to have a high and low speed shift on the meter so if it is running at 12 in. per hour and you want a very accurate reading, throw the lever to high speed and get 12 in. per minute which will show all the variations in the load.

The recording voltmeter is very essential in studying voltage variation in certain circuits where there are heavy loads on the circuit and where the circuit has been increased until it is overloaded. It can be connected and left for a time and will show all the variations during that time.

The use of the ammeter is to record the flow of current and is the most commonly used meter to study and check loads and for trouble shooting. It is simple to connect to a circuit and gives a good indication of the load. It is often used to determine the setting of current and overload relays.

However, if a more precision record is required, the wattmeter is used, and if all three are used, the power factor of the load can be determined, which is a very important factor.

The advantage of recording meters over indicating meters is that a record or picture of the load is obtained for future reference. A good system is to make a record of the load when everything is operating at or near 100 per cent and file it away. Then after a period of time, take another and compare the two. Trouble can sometimes be detected in this way, or it may show that conditions have changed and production can be increased.

It is surprising how many parties outside of the electrical department who like to study these charts; the master mechanic can detect trouble in the machine; the production manager can see if the machine is kept in full production; the works manager also likes to study them, and finally the records are a wonderful means of settling disputes.

CENTRALIZED LUBRICATION OF CRANES

by A. E. MOULD

Industrial Engineer

Tidewater Associated Oil Co.

Buffalo, N. Y.

▲ IN my many years of experience in dealing with all types of industrial lubrication problems and seeing the advanced changes which have been made in the various methods and applications to improve lubrication, I find that very little thought or action has been taken as to centralized lubrication of cranes. This is a piece of equipment that is very essential to the steel mill and to a great many other industries, but it is still the general practice today to have the operator responsible for the lubrication of his crane. The equipment with which he has to grease his crane usually consists of a hand operated grease gun and an oil can. He is expected to walk around and reach all parts of the crane to be lubricated, which in itself is very hazardous.

Thought should be given with regard to centralized crane lubrication which saves time, saves lubricant, saves power and reduced repairs, and which will help to prevent accidents and eliminate shutdowns. I have found in a great many cases that the grades of grease and oil in use have not been suitable for the specific operating conditions involved. The various weather and climatic conditions, as well as the chemical fumes or gases to which a crane may be subjected, should be

taken into consideration in recommending the proper lubricants. These recommendations should be made by the lubricating engineer of the plant, and if the plant does not employ a lubricating engineer, one of the major oil company engineers should be consulted so as to be sure that the right lubricants are used for the particular job.

Experience has shown that many advantages are to be gained by converting from hand to centralized lubrication, the accumulated savings of which are usually more than enough to justify the cost of installation. Among these advantages are:

1. Reduction in labor cost of greasing.
2. Reduction in the quantity of lubricant consumed. Each bearing receives a controlled amount of lubricant at definite intervals and wastage is eliminated.
3. Improved lubrication with fewer bearing failures and reduced maintenance cost.
4. Drippage of lubricant on the floor below or on the goods being manufactured is eliminated.
5. Greater safety because with centralized lubrication it is not necessary for the operator to climb all over the crane in an effort to reach all bearings.
6. Greater availability of the crane because of the reduction in the time required for greasing.

One of the most important of the aforementioned advantages of centralized lubrication is prevention of lubricant drippage. Grease or oil drippings on goods in the process of manufacture may necessitate an additional cleaning process or result in rejections and losses. Most important of all, prevention of drippage eliminates the hazard of slippery lubricants on the floor.

When bearings are converted to centralized lubrication, it is desirable that attention be given to other parts not so lubricated so that improved lubrication will be general and not confined to certain bearings only. For example, if the crane is of the older type equipped with open gears or with gear housings that are not oil tight, housings should be provided, or made tight if installed, so as to prevent lubricant drippage from this source. Also, if master car builders type axle bosses are not adaptable for centralized greasing, provision should be made for installing drip pans to prevent drippage of oil.

By carefully planning to carry out the above procedure, you can more than offset the cost of installation. Insurance companies are very much interested as well as your safety control committees in eliminating these types of hazards. Regardless of whether you carry your own compensation or an insurance company carries it, it affects your cost in the event of an accident or death. This can help to bring about a greater saving to the management in a period of time.

DISCUSSION

PRESENTED BY

V. C. ORANGE, Superintendent of Maintenance, Atlas Steels, Ltd., Welland, Ontario, Canada

A. E. MOULD, Industrial Engineer, Tidewater Associated Oil Co., Buffalo, N. Y.

V. C. Orange: Mr. Mould, how many cranes should one oiler be able to take care of under a centralized lubrication system for cranes? Also, how often do you have to lubricate a crane when using this system?

A. E. Mould: I would estimate that a competent man could take care of 10 or 12 cranes, providing they were not scattered over too large an area. The lubricating schedule, however, is very indefinite, depending upon the crane in service; however, with a competent man in charge, the various movable parts can be carefully examined and a schedule can be set up without very much difficulty.

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ESTABLISHING A PREVENTIVE *Maintenance Program*

By GEORGE T. WRIGHT
Supt. of Mechanical Maintenance
Dominion Foundries & Steel, Ltd.
Hamilton, Ontario, Canada

. . . . inspection and reporting procedure are two essential steps in setting up a preventive maintenance program . . . .

▲ WITH the increased cost of labor and material and the demand for higher production, management wants to eliminate machine breakdowns and decrease maintenance costs. Setting up a preventive maintenance program will help to cut costs and reduce delays.

The system has three phases: First and most important, planned inspection and repair; second, delay reports and summaries; third, machine cost and monthly cost reports.

In setting up the inspection schedule, cards are made out for each machine listing the various points to be inspected. Each machine has a daily inspection card, a weekly card and possibly a monthly card.

The millwright or electrician who is making the inspection takes the card from the foreman's office, makes the inspection and returns the card to his foreman.

The foreman then looks over the card and notes any work that has to be done. This work is laid out for the next shutdown or is done right away if necessary. The card is then signed by the millwright foreman and sent to the maintenance engineer's office where it is posted on a board which shows what inspections are complete and which are still to be done.

Daily inspections are usually made while the machine is running and the weekly inspections are made when the machine is down.

The daily electrical inspections consist of checking the commutators and brushes of d-c motors and the oil rings and oil level of sleeve bearing motors. Contactors are also inspected daily. Meggar reading are taken on shutdown days and faulty contactors are replaced. Motors are also blown out weekly.

The daily mechanical inspections range from routine checks on diesel locomotives to inspecting pickle tanks for leaks.

The weekly mechanical inspections are made on the down shift and include more detailed inspections and repair of any defects that have shown up during the daily inspection.

All this sounds very simple but the catch is in trying to get the machine down to make the inspection and do the work.

It is usually very difficult to convince a mill superintendent that a mill which has run 20 shifts without delay should be shutdown and gone over. However, if the machine is to be kept in good operating condition it is essential that the machine be shut down and inspected and repaired at regular intervals. It is also important that the co-operation of the management be available in this regard.

The delay reports are made out by the operators of the production lines and these record any delay giving a brief description and the probable cause. These reports are sent to the maintenance engineer's office where they are classed as mechanical, electrical or operating delays.

A daily summary is sent out to the department head and the millwright and electrical foremen.

These reports are totalled at the end of the month and a report is made up showing the total delay for the month, figured as a percentage of operating time. The delays for the year to date are also shown which tell the maintenance foremen whether delays are increasing or decreasing.

In the long run the test of any maintenance department is whether it is giving the most economical service consistent with the minimum of delays.

To do this it is necessary to know the maintenance cost of each machine. In the system under discussion each machine has a number and the costs are accumulated against this number by the time office, accounting department and maintenance office.

At the end of each month a report is sent out by departments and every three months a report covering each machine is sent out.

These reports compare the budget figure with the actual cost, the items which are excessive are gone over to find out why and try to correct them in the future.

An example of this was the vertical roll drive gears on our 27 in. 2-high universal mill. These gears previously had a life of about two weeks before being welded which gave a very high cost. With the cooperation of the metallurgical department, a special heat treatment was developed to give a brinell hardness of 365-375. These gears have now been in service about 18 months and are not worn out yet.

The cost reports also show the value of good engineering on the original installation. Machines which have been designed generously for the job have low maintenance cost which pays back their higher first cost.

The most important factor in decreasing delays and maintenance costs is the attitude of the operator. The co-operation of the operating department in not abusing machinery and giving the necessary time for maintenance work is essential to the success of any maintenance program.

However, with the co-operation of the metallurgical department, the engineering department and the operators, a preventive maintenance program will definitely reduce delays and cut costs.

Presented before AISE Buffalo District Section Meeting, January 11, 1949

INDUSTRIAL DIESEL ELECTRIC LOCOMOTIVE MAINTENANCE

By L. W. WELLS
Field Engineer
General Electric Co.
Buffalo, N. Y.

. . . . a regular inspection program is essential for the maintenance of diesel electric locomotives . . . .

▲ THE industrial diesel electric is a slow speed locomotive that varies in size from 20 to 80 tons and is more suitable for switching around an industrial plant than the heavier high speed railroad type diesel electric locomotive. The horsepower varies from 150-hp single engine on the 20-ton to two 150-hp engines on the 45 and 50-ton and two 275-hp engines on the 65 and 80-ton locomotives.

The diesel electric locomotive in industrial plants generally requires more maintenance than it would if it were hauling the same tonnage on some railroads due to the dust and dirt. If the maintenance is done systematically there will be only a minimum of work required with the locomotive working under very severe conditions.

DAILY INSPECTION

This maintenance should start with the daily inspection. It should be made by one man who is familiar with the overall locomotive. On this inspection, the locomotive should be looked over in general, checking the oil in the engine, the air compressors, and the electrical equipment. While the engine is running, listen for any unusual noises and check that the instruments indicate oil pressure, air pressures, and battery is being charged. Blow down the main reservoir to get the

WEEKLY INSPECTION

A more complete inspection should be the weekly one. The number of locomotives will determine how many weekly inspections this man will have to make each day so that all of the locomotives will receive this inspection each week.

The weekly inspection should include the same check made as on the daily and also the checking of the battery charging generator voltage with an accurate voltmeter. The specific gravity of two cells should be checked. In order to get different cells each week, two of the caps should be painted some color to distinguish them from the rest. After the check is made move these painted caps to the next two cells. The condition of these cells will determine if the charging rate is right. If the specific gravity is dropping, the voltage of the charging generator should be raised approximately one-half volt. If the battery is using too much water, the charging rate should be lowered approximately one-half volt at a time until the condition levels off. These inspections can be made in the yard where the locomotives are working or when they are in for fuel.

MONTHLY INSPECTION

The monthly inspection requires the locomotive to be brought into the diesel house. The locomotive should be blown off with dry air as thoroughly as possible before it is taken inside the shop. After it is over the pit and the covers are removed from the traction motors, they should be blown out well. The main generator and the battery charging generator are also places where the dust is likely to stick as these generators will pick up a film of oil if there are any oil leaks around the diesel engine. All of the electrical equipment should be blown out well before the engine is opened up. The electrician should check all the brushes and determine if they are long enough to last another month.

The batteries should be washed off with a solution

Figure 1 — This 45-ton diesel electric locomotive is typical of those engaged in switching operation.

Presented before AISE Buffalo District Section Meeting, January 11, 1949

of soda and water and rinsed off with clear water and blown off with air.

The lube oil filters on the engine should be cleaned and repacked. The filter manufacturers have developed a waste packed sock which can be applied in less time that it would take to pack them with bulk waste, thus insuring that the filter is packed with the right amount of waste. In using bulk waste the filter would often be packed too tight and sometimes too loose. In either case, the oil would not be thoroughly filtered.

The valves should be adjusted to the proper clearances.

The air intake filters should be cleaned and oiled according to the manufacturer's specifications. This is very important as dirty filters will restrict the air flow to the engine and an engine choked for air will not burn all the fuel injected. This will cause loss of power and the excess oil not burned will wash the lube oil from the cylinder walls causing excessive liner and ring wear and also dilute the lube oil.

The viscosity of the lube oil should be checked and the oil changed if the viscosity is below the engine manufacturer's specifications. The oil should be changed on the basis of the hours worked specified by the engine manufacturer. This will vary on different types of engines.

The fuel oil filters should be cleaned and a small amount of fuel oil drained from the bottom of the fuel tank to remove any water sediment that has collected. This is very important as a small amount of water can do a lot of damage to the fuel pumps and the injectors which get all of their lubrication from the fuel oil.

The fuel oil storage tanks in all plants should be equipped with a valve in the bottom so that a small amount can be drained out to keep it free of water.

QUARTERLY AND SIX MONTH INSPECTION

The quarterly and six month inspection will include the monthly and also some testing of the air brake equipment as required by law.

The traction motor armature bearings and the main generator bearing will at this time need some grease added. This should be done according to the greasing instructions of the locomotive builders. Their instructions will tell how many ounces of grease should be added on 24-hour operation each day. This is important as too much grease will break through the seals and cause considerable trouble. Most of the good grease guns are marked how many strokes are required per ounce of grease. They can be checked by counting the strokes and weighing the grease.

ANNUAL INSPECTION

At the annual inspection, or between 7000 and 8000 hours of operation, all the locomotive equipment should be overhauled. Some engine manufacturers require that the engine be overhauled at more frequent intervals.

In most large industrial plants where they have several locomotives, a large stock of spares are kept, such as engines, traction motors, generators and some miscellaneous parts. In that case the locomotive will need to be held in the shop only long enough to change out the units.

The engine and generator are assembled on one common base and can be worked on much easier if it is out of the locomotive. The generator can be removed and sent to the electric shop. There a good clean up, insulation test and the bearing cleaning and repacking will probably be all that is needed.

After removing the generator from the engine, the engine can now be placed on some good blocking to get it up off the floor to make it easier to work on.

The injectors and the fuel pump assembly should be removed and taken to a dust free room to be overhauled by a good mechanic who is familiar with them. He should be equipped with the proper tools and spare parts for the job and should have testing equipment so that the equipment can be tested and adjusted before it is put back on the engine. These parts can be "unit exchanged" with the engine builder's service shop in most cases if desired.

The piston and cylinder liners should be pulled. After the old rings are removed from the piston, the piston should be soaked in a carbon removing solution. The ring grooves should not be scraped with a sharp instrument, use a piece of hard wood if necessary so as not to scratch them.

Wrist pins and bearings should be checked and replaced if necessary.

The liners may not be worn to the limit but they still may have a shoulder at the top of the ring travel. If so, this ridge should be removed. Place in a lathe and turn out the liner from the ridge to the top of the liner so that the new top ring will not hit a ridge and break. Care should be taken to get all of the rings in right side up, especially the oil scraper rings.

New seals should be used on the bottom of the liners. In most cases these are three small round neoprene rings that fit in grooves on the outside near the bottom of the liner. A soft soap spread on these rings will help them slide into the engine frame without rolling out of the liner grooves when installing the liners. A hone should be run through the liners three or four times to break the glaze. This will cause the rings to wear in sooner and not allow the engine to pump oil.

The engine heads should be reconditioned and the valves ground in.

After the engine and generator have been reassembled and placed on the base ready to go back into the locomotive, the generator should be hooked up to a load box and the engine run a few hours with a light load. If everything is satisfactory, run with about half a load. This will help break the engine in before going out on the locomotive and being put up to full load.

If this engine came off a two engine locomotive it will probably go back on the same locomotive only on the other end. The other unit then should be overhauled.

The whole locomotive should be cleaned and painted at this time if necessary.

The air compressors may need overhauling at this time. This can be determined by the orifice test and the amount of oil the air compressors are using. If the piston rings and cylinders are worn, the compressors will not hold up the pressure in the orifice test and they will use a considerable amount of lube oil which will

show up the main reservoirs when they are blown down.

The traction motors on these locomotives should be cleaned up at the time the trucks are removed for wheel turning or changing. Having one or two spare trucks equipped with traction motors will allow the locomotive to be working while the wheels are being turned and the motor and rest of the trucks overhauled. If the motors are cleaned when the trucks are out for wheels, it should not be necessary to remove the trucks at any time for motor repairs except in case of accidental damage. The bearing and bearings should be checked and handled with care so that no dirt will get in them.

The wheel wear will determine when the trucks have to be removed. If the locomotive is working on sharp curves the wheel wear will be more rapid than if on straight track.

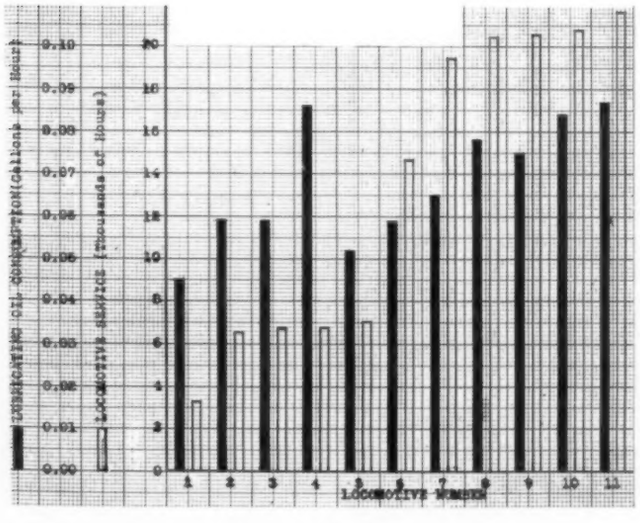
INSPECTION AND MAINTENANCE RECORDS

It is one thing to know how to make these repairs and another thing to know a year from now just what repairs were made. This is where a good record system is valuable. Most all of the equipment on these locomotives has a serial number on it. The diesel shop foreman should take down all of the serial numbers on each new locomotive when it is first put in service. These numbers along with his records of what was done on a certain locomotive will help him keep a record of the equipment when it is changed from one locomotive to another and the amount of service he is getting out of each motor, generator or engine.

The batteries have a serial number. This should be kept with the record of the battery condition. This should tell how much service the battery has given. Each six months a reading of the gravity of each cell should be recorded. As long as the reading of all the cells stays about the same, this will indicate that the battery is in good condition.

In the large industrial plants where spare engines, generators and spare trucks equipped with traction motors are stocked it will not be long before the equipment on the locomotives will be interchanged. Fuel pumps from one engine to another, generators from one engine to another; and engines from one locomotive to another. Without a good record system in a short time no one in the mill will know what engine or electrical unit came with what locomotive, and when a piece of equipment fails they will not know how long it has been in service.

Figure 2 — The graph shows that the locomotives with high oil consumption are, in general, those with the longest periods between complete maintenance overhauls.



SUMMARY

In closing, the importance of setting up a scheduled preventive maintenance program overhauling the units at regular intervals and keeping a good record system cannot be overstressed. One may think this makes a diesel electric locomotive expensive to operate, however, the overall cost of operation of a diesel electric locomotive in an industrial plant per hour is approximately one-third that of a steam locomotive.

DISCUSSION

PRESENTED BY

E. BARKLEY, Republic Steel Corp., Buffalo, N. Y.

L. W. WELLS, Field Engineer, General Electric Co., Buffalo, N. Y.

BERNARD T. COLE, Application Engineer, Westinghouse Electric Corp., Buffalo, N. Y.

E. Barkley: You refer to and you have stressed the necessity of an annual overhaul. Is it actually your experience that this frequency is necessary?

L. W. Wells: Yes, on small type locomotives and high-speed diesel engines it has been found to be quite necessary. If they are allowed to go further than that, you will lose efficiency in your engine. If you were to put the engine on a water-box after a year's operation you will find it does not have the horsepower it should have. That has been our experience in most cases. As far as the operator is concerned, he does not notice the difference very much but if you were to put it on a water-box you would notice your horsepower is down considerably.

E. Barkley: What difference do you find in two engines with 150 hp apiece against one of 300 hp?

L. W. Wells: The one thing some people say is, "Can I run this locomotive on one engine if I have two engines?" Yes, one engine takes care of one end and the other takes care of the other. They are separate units tied together with a throttle system and they may be operated separately. If it is necessary to operate the locomotive on one engine, it can be done safely by taking less load than if you had both engines running. If you had one 300-hp engine and it failed, you would have to be pulled into the shop. Some people prefer the two engines and others like to have the one.

E. Barkley: We are considering the purchase of a locomotive of this type. From your remarks I take it you would recommend that we have a spare unit, that is, an engine, generator and traction motor in order to keep our locomotive at the highest point of availability.

L. W. Wells: That would be true after a locomotive

is a year old or older, since you would have maintenance work to do. On a locomotive when it gets to a point where you want to do an overhaul, such as the annual, if you had a spare it would save you some time on operations; otherwise you would hold the locomotive in the shop to do an overhaul on the engine. If you had a spare, in eight hours you probably would have the locomotive out again. You probably would not require that spare engine and generator until your locomotive is at the point where you are ready to do the annual.

Member: We recently purchased one of your 80-ton locomotives and at the moment we are at a loss to know how we are going to change a truck. We have only a 10-ton crane over the locomotive.

L. W. Wells: The way most of them do is to jack it up. You have to have a solid footing under your power jacks. In most places which have a concrete floor, they dig down under that and put in what they call jacking pads. With a good solid foundation you would not have any trouble jacking up the locomotive but you will have trouble lowering it. That is where you want to be careful so it will enter the center casting when it comes down because you will only have about a quarter inch. The way to do that is to have the jacks on solid footing. When it starts to come down keep taking measurements on each side of the locomotive to keep it coming down level.

Member: We have an idea at the moment of raising the locomotive frame off the truck, putting a small cart, heavily constructed, and very low, with jacks underneath the truck, jacking it up underneath the trucks.

L. W. Wells: That can be done but no one in this territory has done it. That is on the principle of a drop table but instead of dropping it you are going to raise up the rails and roll the truck out the side of the locomotive. If you come out the front you will have to jack up your locomotive to clear the coupler and you will have to jack up the other end some on the truck you are leaving it.

Bernard T. Cole: What electrical equipment is required in diesel roundhouse and for field test and check?

L. W. Wells: The serviceman should have his own meters. The ohmmeter is the handiest instrument in the shop although they should be equipped with other instruments, such as an accurate voltmeter that on which can be read a half volt. The serviceman should have a high potential test set and a megger for his annual, especially if he is under ICC rules and he should have a water-box for loading the locomotive if he wants to know what his horsepower is and what his engine is doing.

Bernard T. Cole: Do most diesel roundhouses have battery chargers?

L. W. Wells: Quite a few of them will have the charger for the batteries to give them a little charge when they are in the shop. It is very seldom they are in the shop. If you have more than one locomotive you are liable to have a spare set of batteries and switch them around and put them on the trickle-charger to keep them in shape.

Bernard T. Cole: Therefore, a trickle-charger and spare batteries is correct?

L. W. Wells: Right, the shop should be able to put batteries on charge and leave them overnight. Occasionally, some of them try to charge with a welder and thus spoil the battery.

APPLYING BEARINGS TO CRANE BRIDGE TRUCKS

. . . . a one-piece bronze bearing has been found to give unusually good service on bridge trucks subjected to exceptionally heavy duty and shock loading . . . .

By HERMAN SANDBERG
Assistant Superintendent, Maintenance
Republic Steel Corp.
Buffalo, N. Y.

▲ THE earliest application of bearings to overhead crane bridge trucks in our experience was the two-piece, or split type, open bronze bearing, many of which are still in use. This design was widely used over a period of many years. It had two major faults. First, no provision was made to exclude grit and dirt, and second, no provision was made to retain the oil after it was applied to the journal. The open end construction was largely responsible for these two sources of trouble.

In recent years the application of anti-friction bearings to steel mill cranes has been on the increase. This type of bearing overcomes the objection of dirt infiltration and loss of lubricant and has many obvious advantages. However, experience indicates that probably there is no one design or type of bearing that offers a cure-all for the many problems of crane performance, and that it is well to examine each functional part separately. For crane bridge track wheel special problems are often presented. Heavy duty cranes in steel mills are subject to rough usage, high duty cycles, excessive wheel loading, and frequent shock loads, all of

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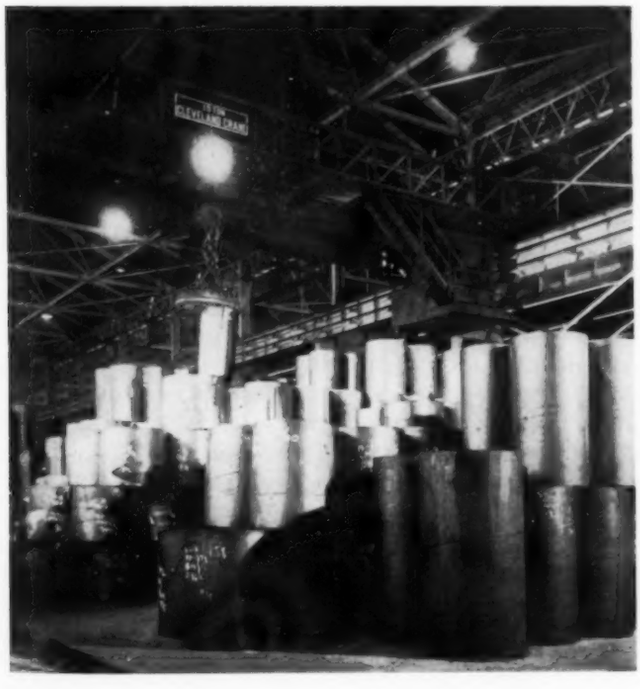
which adds up to an operating condition quite different from that found in, let us say, a warehouse crane. Under conditions of shock loading a bronze bearing is often preferred.

Some years ago a one-piece design of bronze bearing appeared which overcame the earlier weaknesses. Instead of the split bearing this is a solid bearing equipped with oil seals. These oil seals effectively keep out the dirt and retain the lubricant. The bronze bushing surrounds the journal except for a cut-away section at the bottom for application of oil which is carried to the revolving journal by the capillary action of the felt lubricator which is installed in the bottom of the journal box.

The bearings are not split, but are made in one piece. Where they are installed on the end of a shaft, the end of the bearing is closed and the inner surface machined to present a thrust surface to the end of the shaft which is also carefully machined and polished. A felt wick is immersed in the oil chamber and by means of capillary action, oil is applied to the end of the shaft.

The entire weight of the crane in addition to all loads it may be called upon to lift is supported by the track wheel mountings. Turning speed of the journals is slow and high inertia effect is present when starting a loaded crane in motion. Proper lubrication is therefore important both to protect the bearings against excessive wear or scoring and to assure quick starts when crane is fully loaded. The use of oil having the proper characteristics is obviously necessary to do the most efficient job of lubrication. Care and regularity are important but they cannot offset the use of a lubricant unsuited for the service involved. Recommendations of the plant lubrication engineer should be followed at all times.

From time to time opportunities to modernize overhead cranes in a steel plant are presented. It has been our feeling that the retention of oil and the exclusion of dirt from the journal surface are the main factors in gaining low maintenance cost and long life in track wheel bearings. In 1938, we had a major overhaul on a 85-ton open hearth hot metal crane. This is an eight wheel crane which carries hot metal in a ladle from the mixer to our nine open hearth furnaces, with runs up to one thousand feet. In addition to handling ninety-five per cent of the hot metal consumed by nine furnaces, it also does considerable floor work with its auxiliary hoist.



With present rates of production, this crane is in almost continuous operation, twenty-four hours a day, seven days a week. Its duties are rigorous and exacting. With a wheel loading of 78,500 lb and requirements of transporting 1500 tons of hot metal each 24 hours and delivering to the furnace just when required, dependable operation is essential and delays are costly.

It was decided to install truck bearings of the described type on this eight wheel crane, sixteen bearings total, during the 1938 overhaul. These bearings, after ten years hard service are still in use and are in good condition. They have outlasted several sets of wheels, which required replacement.

Based on this experience we would not hesitate to recommend consideration for this type of bearing on the trucks of any crane which is subjected to exceptionally heavy duty and shock loading.

We have since installed this type of bearing, on a number of cranes, including blooming mill soaking pit cranes and open hearth charging machines. Our experience to date with these later installations indicates a life expectancy at least equal to that of our first application.

DISCUSSION

PRESENTED BY

R. W. GRAHAM, Electrical Superintendent, Bethlehem Steel Co., Lackawanna, N. Y.

HERMAN SANDBERG, Assistant Superintendent Maintenance, Republic Steel Corp., Buffalo, N. Y.

R. P. M. CARMODY, Manufacturers Representative, Ohio Electric and Manufacturing Co., Buffalo, N. Y.

R. W. Graham: I would like to ask Mr. Sandberg what was the life of the brass two-piece bearings before the changeover to the new type described?

Herman Sandberg: On this particular crane with the conventional type, we had to renew those on the drivers approximately every six months. Every two months we had to line up the line shaft on account of the pinion going too deep.

R. P. M. Carmody: How often do the wheel lubricators have to be changed?

Herman Sandberg: The wheels had to be changed in seven and eight years. At that time the lubricators on these drivers were renewed. On the idler wheels that are not driven the last lubricators were installed in 1938. On a conventional box it would be practical to change the lubricator, let us say, once a year, and on this particular crane and all the installations that we have made, we have a one-gallon tank on each corner of the crane with a glass top which regulates the oil, and this gallon of oil is consumed in a period of ten days. I believe that has something to do with the belt lubricators lasting ten years and a little over.

MAINTAINING HEARTHS

in Heating Furnaces and Soaking Pits

By CHARLES N. JEWART
Ceramic Engineer
Bethlehem Steel Co.
Lackawanna, N. Y.

. . . . the refractory material which is best suited for a given installation can be best determined by actual test experience . . . .

▲ THE maintenance of hearths in heating furnaces in a steel plant is an ever-present problem, in view of the demand for increased tonnages from the operating personnel. Space does not permit the discussion of all the various types of heating furnaces found in a steel plant. The ones chosen for discussion in detail, include batch-type regenerative furnaces and single, double and triple fired continuous furnaces with recuperators.

32 IN. RAIL MILL

The 32-in. rail mill has two furnaces for reheating blooms. These furnaces are located in the process line between the 44 in. mill and the rail mill itself, and they serve to bring the temperature of the blooms from approximately 1800 F up to a range of 2200 to 2400 F, the temperature depending on the steel analysis.

These furnaces are of the regenerative type with checker chambers similar to those in an open hearth furnace, and they operate on a mixture of coke oven gas and blast furnace gas of approximately 230 Btu.

The hearth of each furnace is 21 ft-3 in. wide from door sill to door sill and the working hearth is 35 ft-3 in. x 19 ft. This flat hearth is divided into eight sections, each 3 ft-9 in. wide and 19 ft long, with a door at each end for the charging and discharging of blooms. Each of the eight doorways are sub-divided into two troughs, 19½ in. wide and 19 ft long. All division walls are made of either first-quality clay or super duty clay brick.

The product charged ranges from a minimum of 5¾ x 6¾ in., 15 to 18 ft in length, up to a 9¾ x 9¾ in. bloom, 15 to 18 ft long. At present, this furnace is being operated for rolling 16 out of 24 hours.

The blooms are pushed into the furnace mechanically from a movable table. They remain in the furnace approximately one-half hour and are then withdrawn from the opposite side by a grabbing mechanism which pulls them out onto another moving table and transfers them to the mill roller line for rolling into rails.

Dragging the blooms across the hearth subjects it to considerable abrasion. The hearth is composed of a series of troughs, large enough to take a single bloom. In the past, these troughs were made up of first-quality brick with approximately 3 in. of ground ganister rock put in as a bed. This ganister absorbs some of the scale and after a time, a liquid forms at the bottom, composed of iron and silica which adheres to the bottom of the bloom and causes markings in the finished product. Due to the periodic operation of this furnace, there are times when the liquid formed solidifies, and additional scale causes a build-up. At other times the temperature is such as to cause the bloom to wear down the bottom of the trough.

In the case of the build-up, it is necessary to spray the hearth with water to chill the scale for easy removal. Some of the ganister comes out with the scale which makes it necessary to bring up the level of the bottom by adding more ganister. If too much liquid is formed and the bottom begins to wear down, ganister added to dry the bottom as well as to build up the level.

At the present time, one of the furnaces has been rebuilt with a basic brick bottom. This bottom has eleven different combinations of basic refractories which include high magnesite, hard-fired magnesite, chrome magnesite, chrome, silicon carbide, fused Al_2O_3 and plastic chrome ore.

This bottom has been in operation since May 5, 1948, or 5 months, and it is too early to give any information regarding the combination that will give the most satisfactory results. It may be stated, however, that all of the troughs are subject to a build-up of scale, but

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that so far, no liquid fluxes have developed to mark the finished product.

During the first two months of operation, no water was used for cleaning the scale, but since that time a small amount of water is allowed to chill the scale for easy removal.

The type of basic bottom which will be installed in the other furnace will be based on the combination of refractories which requires the least maintenance.

10 IN. BAR MILL

The heating furnace for the 10-in. merchant mill has an overall width of 35 ft-4 in. and an overall length of 63 ft-1½ in. The working hearth is 33 ft wide and 55 ft long.

This is a continuous, recuperator-type, single-zone furnace in which bars ranging from a minimum of 2½ x 2½ in. x 30 ft to a maximum of 4 x 4 in. x 30 ft are side charged at one end and the side discharged at the other end ready for rolling.

This furnace has a single set of burners located at the discharge end and directed toward the incoming charge. These are capable of burning either a mixture of coke oven gas and blast furnace gas or fuel oil.

Rated at 80 tons per hour, the furnace has produced as high as 98 tons per hour. The charge enters the furnace cold on cast iron skids, most of which are 2 ft-3 in. apart and extend from the charging end down to a point 23 ft-6 in. from the discharging end. The spaces between these skids are bricked in with second-quality, hard-burned brick. The last 23 ft-6 in. of hearth, which includes the soaking and discharge hearth, are covered with 7 in. of plastic chrome ore.

When completed, the furnace was heated to 2350 F and held for 16 hours, to burn in the plastic chrome ore hearth, after which it was allowed to cool to 1600 F and then brought back to a rolling temperature of 2200-2300 F. This furnace has been in operation since May 27, 1947, or about 16 months, and requires very little hearth maintenance. A small patch, 2 x 4 ft at the discharge end had to be repaired on June 5, 1948, after twelve months operation. Up to this repair, 180,000 tons of billets had been heated in the furnace.

12 IN. MILL BILLET-HEATING FURNACE

The 12 in. bar mill has two reheating furnaces, both of which are of the recuperative, continuous, two-zone type, fired with oil or a mixture of coke oven gas and blast furnace gas. The fuel for the soaking zone is introduced through burners evenly distributed across the discharge end, while fuel for the heating zone is supplied through six burners spaced evenly across the furnace approximately 15 ft in front of and approximately 3½ ft above the soaking-zone burners.

The hearths of these furnaces are 17 ft-0 in. wide inside the brickwork, and are 50 ft-0 in. long from the charging door to the center of the discharge door.

Bars ranging from a minimum of 4 x 4 in. x 7½ ft to 15 ft long, to a maximum of 5 x 5 in. x 7½ ft to 15 ft long are end-charged cold and travel down the hearth, which has a slope of ½ in. per ft, through the heating zone and then through the soaking zone. They are finally side-discharged from the soaking zone.

The hearth, from the charging end to the beginning of the soaking zone, a distance of approximately 41 ft, is composed of first-quality clay brick, with steel billets 4 x 4 in. used as skids. These skids are approximately 3½ ft apart and extend about 1 in. above the brick hearth.

The last 11 ft of the hearth, which is known as the soaking zone, has no metal skids but is made up of 4½ in. of plastic chrome ore. In preparing the hearth, the plastic chrome ore is rammed into place, heated to approximately 2350 F and held for 16 hours, then allowed to cool to 1600 F, and finally brought back to a rolling temperature of 2200-2300 F.

Each furnace is rated at 30 tons per hour, but as high as 40 tons per hour have been produced per furnace.

A furnace bottom will stand up for eighteen months before a replacement is necessary. It may require one or two small patches during this period. This represents a total amount of 130,000 tons per bottom per furnace.

SLAB REHEATING FURNACE BOTTOMS

In 1936 when the strip mill was built at the Lackawanna plant, three-zone controlled, triple fired, continuous, recuperative, slab-reheating furnaces were installed. The soaking zones in these furnaces were 18 ft wide and 16 ft-9 in. long and made up of four rows of dry, low-carbon steel skids, spaced approximately 3½ ft apart. The material between the skids was plastic chrome ore. These dry, low-carbon steel skids were lined up with the wet skids at the charge and discharge ends.

The average tonnage pushed over these bottoms in 1936 was approximately 500 tons per furnace per day, and the average life of the hearths approximately one year.

However, during the first year of operation, it was found that the low-carbon, dry steel skid built up with scale from the slabs and that the removal of this scale from the skids was difficult and caused considerable delay in cleaning bottom.

As a result of the experience encountered during the first year of operation, hearths were made with plastic chrome ore but without the low-carbon steel skids. These hearths were burned in for a period of 8-16 hours at 2550-2600 F, chilled to 1800 F, and then brought up to rolling temperature of 2350-2400 F.

The all plastic chrome ore hearth gave satisfactory results considering the increased output per furnace per day, which rose gradually from 500 tons in 1936 to over 1000 tons in 1942. However, in 1943, the life of these hearths showed a marked decrease. Some of the hearths lasted only 2½ months or had to be replaced after 60,000 tons had been charged. This sudden decrease in hearth life was attributed to a probable inferior quality of plastic chrome ore.

In 1944, in an effort to increase hearth life, slab reheating furnace hearths were installed with silicon carbide skids along with the plastic chrome ore.

These silicon carbide skids were lined up with the

wet skids at the charge and discharge ends. Use of the silicon carbide skids increased the hearth life to about eight months, with some patching. This meant that the tonnage per hearth increased from a low of 60,000 tons in 1943 to a high of 225,000 tons in 1944. The life of these silicon carbide skid bottoms varied, however, as any overheating of the slab would cause the scale to liquefy and react with the silicon carbide skids, dissolving them.

When the fourth furnace was built, in 1946, the hearth was also made with silicon carbide skids and plastic chrome ore. This gave good service for six weeks, after which the hearth began to cut out. The back half of the hearth was replaced, using fused cast aluminum oxide blocks as skids. These blocks are very resistant to abrasion, but they have a tendency to spall when water is used in the hearth for cleaning bottom.

Mayari steel skids, in combination with plastic chrome ore, have been tried, but it was found that the scale stuck to the skids and that the skids oxidized quite readily.

High alloy skids were installed in No. 2 slab reheating furnace on February 16, 1947, together with plastic chrome ore. The skids were 12 ft long, 2 in. wide, and 9 in. high, and of the following composition:

Carbon	Manganese	Phosphorus	Sulphur
0.09	1.70	0.019	0.010
Silicon	**Copper**	**Nickel**	**Chromium**
0.49	0.09	14.30	23.52

This hearth was in service for nine months before it was necessary to patch it at the center, and it lasted 11½ months before being replaced, with a total of 325,090 tons of slabs heated.

This compares well with the previous hearth installed with silicon carbide skids and plastic chrome ore which needed repair after 2½ months' operation. Five other repairs were necessary to maintain the hearth for a period of 9.1 months or a total of 234,571 tons of slabs heated.

Since then, alloy skid hearths have been installed in all of the furnaces. Some bottoms have been installed with six rows of alloy skids in place of four. Due to the variation in the size of slabs rolled, some of these skids are exposed to the direct heat of the furnace a greater percentage of the time and seem to oxidize away. An alloy skid apparently gives the best results when it is covered continually with slabs.

Some trouble has been encountered with the alloy skid becoming knife-edged under the surface next to the plastic chrome ore, which may mean that the alkali in the plastic chrome ore is causing a breakdown of the alloy. In future installations, it may be necessary, therefore, to specify a stabilized alloy or to put a fired refractory between the alloy skid and the plastic chrome ore.

The experience at Lackawanna is that a plastic chrome ore hearth is easier to clean than a brick hearth. However, any chrome-base refractory swells, due to iron oxide absorption.

The time may come when it will be economical to install a hearth of some material such as cast Al_2O_3 blocks which have a high resistance to liquid scale, and will cut furnace bottom delays to a minimum.

SOAKING PIT HEARTHS

At the Lackawanna plant, both the regenerative and the recuperative one-way fired types of soaking pits are in use. The regenerative pits have checkers requiring a periodic reversal of the fuel while the recuperative type fires continuously in one direction with the fuel being introduced at one end near the top and the waste gases withdrawn at the same end but at a lower level.

The size of the regenerative-type pit ranges from 7 ft x 11 ft to 7 ft x 16 ft, while the recuperative pits are 7½ ft x 20 ft. The fuel used is a mixture of blast furnace gas and coke oven gas of approximately 140 Btu. Bottoms are usually made of first-quality clay brick with either one or two openings approximately 12 in. in diameter, for cleaning purposes. These openings are covered with a round clay tile, 14 in. in diameter and 1¼ in. thick, to retain the working bed above. When it is necessary to remove the working bed, the tiles are broken and the old bed is pushed out into hopper cars below.

The working bed or hearth of the soaking pits is made up of a layer of coke breeze which ranges in thickness from 18 to 20 in. Coke breeze is used as a hearth material because it is granular and allows ingots with uneven bottoms to seat themselves and remain upright away from the pit wall. The nature of the coke breeze prevents it from fluxing with scale and slag from hot top materials not removed in the stripping operations and allows it to be easily broken up and removed from the bottom.

This hearth needs attention every three to four days, depending on existing conditions.

In cases where the pits are not subjected to either excessive scaling of the ingot or to overheating, very little slagging action of the coke breeze takes place. After three to four days operation it may only be necessary to add more coke breeze to take care of what has burned away, in order to maintain the hearth level.

On the other hand, if either excessive scaling of the ingot takes place in the pit, due to temperature changes, or if the pits run hot, causing the ingots to drip, a considerable amount of liquid slag develops in bottom, making it necessary to remove the slagged hearth and make up a fresh one.

A hearth of coke breeze is made up by loading it in a special box which is slightly smaller than the pit and has a trap door at the bottom. This box is lowered into the pit, and the trap door opened. Thus the coke does not have very far to fall and very little of it is carried away. After the coke breeze is emptied out, the box is used to level it in the pit.

As a rule, the coke breeze is damp and causes a spalling conditions in the pit at the slag line.

For the past few years, the trend has been away from chrome brick at the slag line, in favor of magnesite. However, magnesite brick do not stand this spalling condition and as a result unfired chemically bonded chrome-magnesite brick are being used with considerable success.

A refractory band protruding approximately 3 in. from the side walls of the pit and placed about 3 ft above the hearth has proved helpful in keeping the in-

gots away from the pit wall at the slag line, thus reducing the reaction between the scale and the slag-line refractories.

DISCUSSION

PRESENTED BY

E. M. SARRAF, District Sales Manager, Harbison-Walker Refractories Co., Cleveland, Ohio

HAROLD V. FLAGG, Combustion Engineer, Armco Steel Corp., Middletown, Ohio

E. C. HITE, Maintenance Engineer, Steel Tube Division, Timken Roller Bearing Co., Canton, Ohio

H. S. HALL, Fuel Engineer, Lukens Steel Co., Coatesville, Pa.

W. W. TRINKS, Associated Engineers, Pittsburgh, Pa.

CHARLES N. JEWART, Ceramic Engineer, Bethlehem Steel Co., Lackawanna, N. Y.

E. G. BUSCHOW, District Manager, Surface Combustion Corp., Pittsburgh, Pa.

C. W. MICHAEL, Steel Mill Engineer, Surface Combustion Corp., Toledo, Ohio

HOWARD E. JONES, JR., Manager Industrial Products Dept., Thomas Brick & Tile Co., Detroit, Mich.

P. F. KINYOUN, Combustion Engineer, Bethlehem Steel Co., Lackawanna, N. Y.

E. M. Sarraf: What struck me, in listening to Mr. Jewart's interesting paper describing three or four types of heating furnaces, is the fact that a dozen different varieties of refractory materials are being used or considered for use in the hearths of those furnaces. Obviously each variety is in itself worthy of use under some particular condition; also obviously, all varieties cannot be equally suitable. Carefully supervised trial installations afford the best means of determining that refractory material most serviceable for the particular operation involved.

The author mentions one furnace wherein eleven different combinations of refractory materials are now under service test and valuable conclusions are virtually assured.

An interesting experience occurred recently in the maintenance of the discharge hearth in a continuous furnace, heating slabs 18 to 20 in. wide by 4 in. thick in lengths up to 30 ft. Following the usual practice during a furnace rebuild, this hearth had been rammed cold with plastic chrome ore, burned in at around 2500 F, chilled and brought back to 2200-2300 F operating temperature. After about five months' service during which the furnace was operated 20 shifts per week, the discharge end hearth became badly eroded and worn. The operators were confronted with the choice of either taking the furnace out of service again for several days to renew the hearth, with attendant loss of badly needed production, or attempting such hot maintenance work as could be done during the single eight hour shift on Sundays, permitted for such maintenance.

Having had satisfactory experience at the open hearth department with an 80 per cent magnesia ramming mix in hot and cold patching of open hearth furnace bottoms, it was decided to try this material for hot maintenance on this discharge hearth, with about 5 per cent of finely powdered iron added to the prepared 80 per cent magnesia ramming mix, to assist in developing a bond more rapidly. The gouged area, some 6 or 8 in. deep in the hearth, was cleaned out and dusted with powdered iron. A stainless steel billet of maximum volume was placed in the hole to speed up the repair. About 2000 lb of the 80 per cent magnesia-powdered iron mixture was applied dry by shovel, sufficient to fill the hole, smoothed out with a scraper and dusted over with powdered iron.

Although the repair could be given only a couple of hours soaking heat, a hard working surface was obtained. It held up very well, and was resurfaced with a few bags of 80 per cent magnesia ramming mix at intervals of a couple of months. This practice permitted production to continue without interruption for over a year, and major repair of the hearth was postponed until the furnace was rebuilt.

Mr. Jewart is to be commended on the thorough manner in which he has approached the problem of finding the most economical refractory materials for the various applications in which he is interested, and his careful service trials now in progress should develop fine results.

Harold V. Flagg: Mr. Jewart's experience is evidently similar to our own. The plastic chrome solid hearth seems to be the most practical solution available and has worked out about the same in our plant as his experience indicates.

The question of skids was interesting. We have gone through about the same experience on this problem but have never tried the alloy skids. We have tried silicon carbide skids but results were not promising. The soft steel skids seem to work out about as well for us as anything we have tried.

Mr. Jewart talked about an alloy skid 2 in. thick. I would like to ask how wide that skid was and how deeply he embedded it into his hearth. The question of knife edging would certainly be a problem. I would like to ask if a thicker skid would reduce that effect.

On the question of soaking pit bottoms, we have a representative of one plant here with us today who does not use any coke breeze but uses a dry bottom. Such practice is hardly feasible for plants working ingots with knobby bottoms which must have some kind of bed so that the ingot will stand up. The question of how soupy the coke breeze becomes is a matter of the amount and the character of the scale formed in the pit, which comes back to the matter of the amount of pit design and operation. A soaking pit can be built and operated so that very little scale is dropped in the pit with the result that bottom making becomes a fairly easy job.

E. C. Hite: Our experience at Timken with our triple zone furnaces, which are heating blooms, has been very similar to Mr. Jewart's. We formerly used 3 in. width alloy skids of the stainless type and they wore down.. Possibly, the alkali content of the plastic chrome was responsible, but we looked at it more as a matter of oxidation. At present we are getting longer life by using 5 in. width skids. We are also using one piece continuous skids but have some trouble in keeping them anchored. We anchor the ends at the slope but have difficulty in preventing them from pushing ahead.

On the subject of soaking pit bottoms, there has recently been some talk about several companies eliminating the "bottom making" operation. The way we understand it, they are allowing the scale and slag to build up in the bottom until some objectionable depth is reached. The pit is then shut down and the solid slag removed in a manner similar to open hearth slag pit removal.

Is there anyone in the audience who has had experience with this and would like to offer comment?

H. S. Hall: In all our soaking pits and side door furnaces we use a cinder bottom. This bottom is built using second quality clay brick. This forms the original working hearth of the pits and furnace. Most of the cinder accumulation is scale jacket which either drops off or is knocked off when the ingots are drawn.

In the 120-in. mill, we operate eight recuperative soaking pits 12 ft-7 in. x 13 ft-7 in., and four recuperative and one regenerative side door furnace.

In the 206-in. mill we operate seventeen holes of recuperative pits ranging in size from 7 ft-0 in. x 12 ft-0 in. up to 14 ft-8 in. x 20 ft-6 in., and twenty-four holes of regenerative pits which are relatively small.

Fuel in both mills is either natural gas or oil. All steel charged is cold steel with ingot weights as high as 110,000 lb.

The slag line is chrome brick and gives good service.

We allow the cinder to accumulate in the bottom of the pits and furnaces to a depth of about 21 in., at which time the pit or furnace is shut down and the cinder removed. This normally requires about five days from the time the fuel is shut off until the fuel is put back on.

The time between cinder removals is as follows: recuperative pits—6 to 7 months; regenerative pits—12 to 13 weeks; side door furnaces 12 to 15 weeks.

We save considerable money on labor inasmush as we operate with only a heater and a helper. No bottom makers or laborers are required.

It requires ten men from 24 to 32 hours to remove the cinder from a row of pits.

No coke breeze is used which is another saving. The bottoms are allowed to air cool, no water being used, since this would be detrimental to the brick work. The cinder is broken up by air hammers and loaded into pans.

W. W. Trinks: I have seen many furnaces which had trouble with the binding. The hearth expanded in operation and then it contracted over Sunday allowing scale to fall into the cracks. Then the hearth expands the next time and pushes out the binding a little bit more, and so on week after week. The binding then becomes so crooked that it has to be renewed and the whole furnace has to be rebuilt. Have these new means of building the hearth overcome that troublesome feature?

C. N. Jewart: I do not recall that we have been troubled with any of the buckstays along the sides of the furnaces bowing out due to expansion of the soaking hearth. The plastic chrome ore is usually rammed into place with no allowance made for expansion. This hearth once installed is in almost continuous operation, with only a few shutdowns taking place during its life. The accumulation of scale in the cracks during these few shutdowns is not detrimental.

In using alloy skids which overlap, we allow room for lengthwise expansion of the skid. The scale does get in this opening and the skids do eventually either push out the back bridge wall or raise up.

The alloy skid gradually disintegrates as is shown in Figure 1.

E. C. Hite: The difficult problem of growth of refractory walls because of joint expansion is still with us. Although many designers have come up with schemes to prevent joint expansion, none have proven to be very practical or satisfactory.

E. G. Buschow: On too many occasions buckstays are too light and hearth expansion provisions are not correct. If buckstays are heavy enough, the hearth expansion pressure will be resisted. It is a matter of strength of buckstays to resist "bow-legged" effect and of adequate expansion provisions. After the initial heating, the hearth blocks are individually free to expand and contract. If the hearth voids are adequate, the hearth exerts very little pressure against the casing.

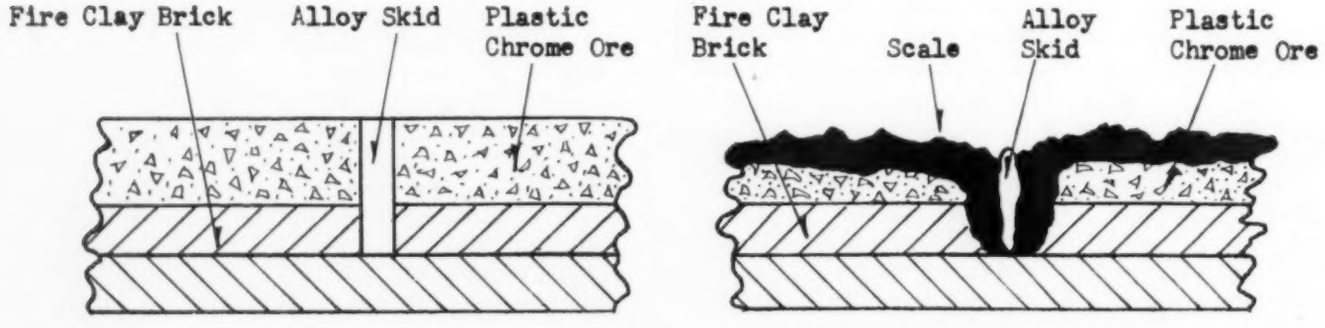
C. S. Michael: It is our observation that any trouble with the bending of buckstays comes from operating the furnaces at greatly increased capacity, and when the brick walls are in need of repairs.

We have not run into any serious trouble from side thrusts of the hearth because care is taken when installing the brick and plastic KN to provide for ample expansion.

I would like to know if they have had any experience in the use of a chrome-magnesite or a similar quality of brick in the hearth in place of plastic KN. I believe some steel companies have used chrome-magnesite brick, covered with a basic ramming mixture coating having approximately 65 per cent MgO, or granular chrome with good results.

C. N. Jewart: We have not tried a whole hearth of

Figure 1 — On the left is shown a new hearth, and on the right is shown typical appearance of the hearth after six months service.



chrome-magnesite brick, but have patched approximately one-third of a hearth with them. Our experience was that the scale stuck to and got between this brick making it difficult to remove. We replaced these brick after a short period of operation and installed a patch of plastic chrome ore.

The plastic chrome ore hearth is monolythic and does not allow fingers of molten scale to penetrate to any appreciable extent. When water is sprayed on the scale to chill it for easy removal, there is no vertical shattering of the plastic chrome ore, and the scale lifts off rather easily, taking off thin layers of plastic chrome ore with it.

At times, granular chrome ore is spread on the hearth to fill in the holes and also to act as a cushion between the scale and plastic chrome ore.

A hearth made of plastic chrome ore is much easier to clean and maintain than one made of chrome-magnesite brick.

Howard E. Jones, Jr.: Regarding the plastic chrome ore hearth, it is well known that this type of material is well suited for reheating furnace hearths because of its high resistance to slag as well as abrasion. However, there are two disadvantages to plastic chrome ore. In the first place, it takes considerable time to pound this type of material in the hearth. In the second place, in pounding it in, it is very easy to get laminations.

Some time ago, one company brought out a castable chrome material which is mixed up like concrete and poured into place. Being a hydraulic setting refractory it is much faster to put in, or install, and is easier to avoid laminations.

I am wondering if Mr. Jewart had any experience with this type of material and, if so, what were the results obtained.

C. N. Jewart: We have not had any experience on this cast chrome and I do not know what they use in their material to set it. It is probably an alumina cement binder with hydraulic setting properties. I am not prepared to comment on it, but I would assume that if it is castable there may be weakness in it at a temperature, say, of around 1500 F. Whether that would cause a shearing below the surface, I do not know.

P. F. Kinyoun: I have heard some discussion as to the proper temperature to "burn in" plastic chrome hearths. I believe Mr. Jewart stated that in the 12-in. bar mill furnace that the materials "burned in" at 2300 F whereas on slab furnaces, similar material is "burned in" at 2600 F. I would like him to explain why the temperatures vary in connection with "burn in" of this plastic material.

C. N. Jewart: Plastic chrome ore is composed of grains of chrome ore together with several bonding agents to facilitate its use over a wide range of temperatures.

As the temperature of the plastic chrome ore is raised, the bonds flux more readily than the chrome ore and attack the grain. When the temperature is raised to 2400 F, for instance, the mass is composed of individual grains of chrome ore surrounded by a bond in a pyroplastic condition. If an attempt is made to use the hearth when it has been raised only to furnace operating temperature, the weight of the steel will push the grains over one another due to the plastic condition of the bond.

If, however, the hearth temperature is raised to 2600 F and held for a period of time (approximately 8 hours) the bond increases in refractoriness due to its attack on the chrome ore grain. Then when the hearth is chilled down to 1600 F the bond has solidified and it remains in a solid form when the temperature is brought back up to 2400 F.

In the case of slab reheating furnace when we expect to roll at from 2400 to 2500 F, the hearth is usually brought up to 2600 F and held for a period of time, chilled, and brought back up to rolling temperature.

In the case of a billet or bloom heating furnace where rolling temperatures are expected to be 2200-2300 F, the hearth is usually brought up to 2450 F, held for a period of time, chilled to about 1600 F and then brought back up to rolling temperature.

P. F. Kinyoun: I think that answers the question. In other words, plastic chrome hearths should be "burned in" at a temperature of 200 F above the normal operating temperature of the finished hearth. This is the point for us all to remember.

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ASSOCIATION OF IRON AND STEEL ENGINEERS, 1010 EMPIRE BLDG., PITTSBURGH 22, PA.

MAINTENANCE OF LIFTING MAGNETS

By K. J. DOLL
Superintendent
Pittsburgh Service Shop
General Electric Co.
Pittsburgh, Pa.

. . . . few pieces of steel plant equipment must withstand as much abuse as the electric magnet . . . .

▲ WHAT is a lifting magnet? Basically it is a large piece of steel with a very simple type of electric coil on the inside.

What is it used for? It is used for sledging, as a skull cracker, as a ram, for pushing and spotting railroad cars, and for many other uses too numerous to mention. Sometimes they are also used for magnetic lifting of steel and scrap.

When, fifteen years ago, I first saw a dismantled magnet, I said to myself, "How is it possible that such equipment, so solidly constructed, can ever develop trouble?" By now, I know better. Since that time I have examined hundreds of magnets and have tried to determine where and how they failed, and tried to find ways and means to correct such difficiencies as could be corrected. Mind you, I said—tried to improve them. Had we been 100 per cent successful, we would have stopped repairing magnets and started building them. Manufacturers recognize the fact that even the most up-to-date magnets will fail, and they now sell you not only a magnet but, so to speak, a refill unit along with the new magnet.

Before we talk about maintenance of magnets, let us first determine where and what failures do occur. Like all other electrical equipment, we have two types of basic failures—mechanical and electrical. Magnets are and always will be, misused in steel mills, and the manufacturers have finally recognized this fact. The newest magnet designs have corrected many of the old shortcomings and they should reduce many of the mechanical failures.

Mechanical failures consist of the following: First, we have the natural wear on the pole shoes. If this wear becomes excessive it may cause the bolt heads to wear off and pole shoes may literally fall off the magnet. Outer pole shoes often develop cracks and they break. The bolts may stretch and allow looseness in the assembly. The manganese steel plates often become bellied and develop cracks. Terminal covers have a tendency to be knocked and sheared off. Regardless of how heavy the steel casing is, many come in with cracks, particularly where the stock has been weakened by drilling the bolt holes. Too many magnet cases develop cracks from the machined inside corners due to the fact that

Figure 1 — A typical example of a battered magnet.

Presented before AISE Pittsburgh District Section Meeting, April 12, 1948

the manufacturer machines the cases with sharp corners instead of using liberal fillets which would completely eliminate such costly repair work on the cases.

The electrical failures are most frequent at the terminal studs which may become grounded or flash-over, because of an open discharge resistance which may burn them. Leads may become loose and develop hot contacts, or they may break, due to looseness of the assembly. Ground failures of leads are frequently due to close space limitations. Turn to turn failures are very rare, however, failures between layers are more frequent. Open circuits occur, not too often, but if they do occur it is always at the crossover from one layer to the next. Strange as it may seem, few ground failures occur between the coil assembly and the winding spool, however, often we do get magnets where a flashover with a resulting ground failure occurs between the outside turn of the coil and the case.

Frequency Rating	Number	Per cent	Cause
1	84	42	Winding wet and grounded
2	36	18	Winding wet, not grounded
3	26	13	Winding wet and shorted between layers
4	16	8	Case or terminal boxes cracked
5	16	8	Roasted coils, resulting in brittle or gassed copper
6	6	3	Worn pole shoes, and non-magnetic plates
7	4	2	Terminal cover loose or missing
8	4	2	Damaged bushings
9	4	2	Grounded
10	4	2	Leads burnt off

To give you an idea how these failures occur, I have accumulated the data on the last 200 magnets we repaired.

The data can be summarized as follows:

1. Most failures occur due to wet coils.
2. Because the magnet assembly has become loose.
3. Because terminal box covers are missing, or if they have been replaced, it is done without sealing them.
4. Because packing and sealing fits have rusted so badly as to destroy the seals.

You can readily see that most failures occur due to wet coils and they show up as an electrical failure. In many instances, however, a wet coil is a secondary effect, and the prime cause is a loose assembly or a cracked case.

As moisture is such a factor in magnet failures, let us examine it a little bit closer. Where does it come from? There is no question that a loose assembly, or missing terminal cover, or cracked cases permit water or moisture to penetrate from the outside. It is not, however, generally recognized that much of the moisture in magnets is produced inside the magnet. This is only true if a magnet is used on "hot" applications where temperatures over 500 F are reached. Most insulating varnishes, binders as well as the filling compounds are organic. At temperatures over 500 F they break down and form carbon products and moisture. Unfortunately, no one has as yet found the solution to this problem. The insulation in magnets and the filling compound should be inorganic, however, most of the known inorganic materials have such characteristics and properties as make them unsuitable for magnet

Figure 2 — This once round magnet has through abuse been battered out of shape.

Figure 3 — The magnet case shows cracks all along the inside corner.

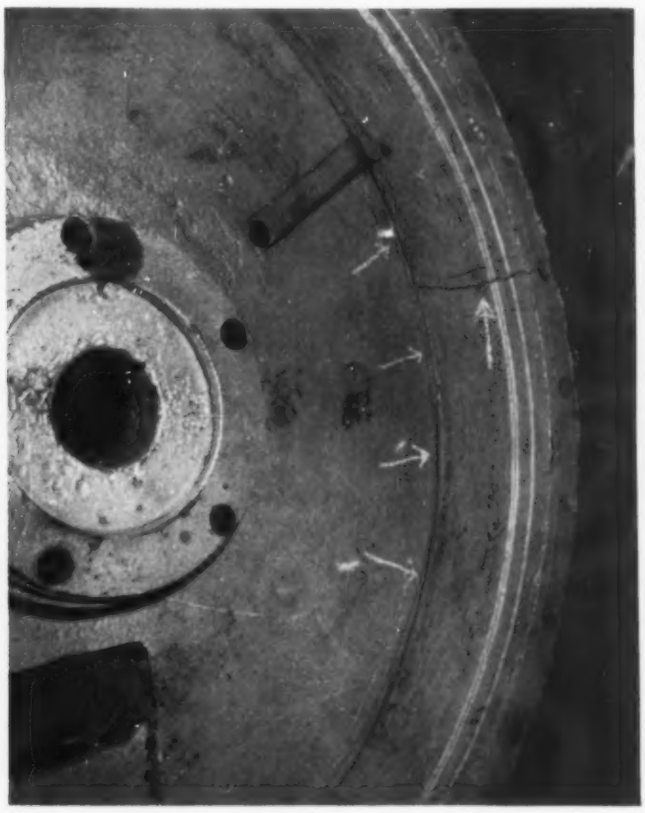


Figure 4 — The center pole of this magnet case shows crack, corrosion and wear.

application. The new line of silicon products may supply us with an answer to this problem.

Figure 5 — A winding spool plate badly corroded.

Now, since we know what failures do occur, we can intelligently prepare ways and means to eliminate, or reduce them.

The most important step in reducing magnet failures is a regular physical check-up of the mechanical condition of the magnet. The next step is to check for moisture by taking insulation resistance readings to ground. The third step should consist of a check-up on the discharge resistor, the cable, trolley wires and contacts between the control cab and the magnet proper. Should an open circuit occur between the control cab and magnet proper, the winding would be completely unprotected against the high inductive voltage generated if a fully saturated magnetic field suddenly collapses.

Before closing let me express only one more thought. You, who are the ultimate users of magnets will have the greatest influence on the type of electric lifting magnets the manufacturers will build. Your thoughts, ideas and constructive criticisms, in co-ordination with the manufacturer's "know-how" will bring the type magnet you need and desire.

DISCUSSION

PRESENTED BY

O. P. ROBINSON, Salesman, Cutler-Hammer, Inc., Pittsburgh, Pa.

A. C. DYER, Vice President, The Electric Controller & Mfg. Co., Cleveland, Ohio

K. J. DOLL, Superintendent, Pittsburgh Service Shop, General Electric Co., Pittsburgh, Pa.

O. P. Robinson: All I have to say is that I never could understand why, after a man spends $5,158 for a 65-in. magnet he does not take better care of it.

A. C. Dyer: Mr. Doll has given us data on the faults that develop in magnets and you notice he says 42 per cent are due to entrance of moisture. That means that there has been a mechanical fault in the magnet or moisture would not have been in there in the first place. Therefore, in repairing magnets, the most important thing is to insure that the fit of the coil in the case and the attached pole shoes are made equal to the original.

When we rebuild a magnet, we take a cut off the case and pole shoes with a boring mill, so that the coil cavity and all seals are re-established. This I think, is the only way to insure successful repairs, otherwise, moisture will again enter and the repair can only be a temporary one.

K. J. Doll: As pointed out previously, not all moisture conditions in a magnet are due to moisture entering from the outside. This has to be evaluated in considering the 42 per cent figure given. A close estimate would be 30 per cent due to moisture entering from the outside. The other 12 per cent represents moisture condition generated in the magnet due to high temperatures, causing a breakdown of the organic material inside the magnet. I agree, however, fully with Mr. Dyer that the reconditioning of the cases, rings and pole shoes is as an important part in magnet repair work as the rewinding of the coil.

PREVENTIVE MAINTENANCE OF ELECTRIC OILS

By CHARLES J. EGGER
Bowser, Inc.
Fort Wayne, Ind.

. . . . it is easier and better to maintain electrical oils, than to try to reclaim them after they have deteriorated . . . .

▲ IN order to prescribe any program of preventive maintenance, it is first necessary to diagnose the case and determine just what it is that we are trying to prevent. The basic facts governing service degradation of petroleum oils may be briefly expressed. These oils are mixtures of hydrocarbons of varying molecular weights and structures, each obeying the laws governing chemical combination; the degree and rate of response depending upon both molecular weight and chemical structure of each individual petroleum hydrocarbon. Chemical action as well as pollution will occur if the oil be employed in circumstances which afford the incidence of external agents, or in juxtaposition with substances which will react or catalyze chemical reactions.

ACID FORMATION

The combination of petroleum hydrocarbons with oxygen is by far the most widespread reaction which normally occurs in most service application. It is, therefore, surprising that the reactions involved and the products formed are not much more generally known. The first attack by a molecule of oxygen will result in the formation of an alcohol. When this has occurred, further oxidation of the alcohol will result in the formation of a ketone. At this stage progressive oxidation is accelerated greatly and the oxygen taking part in the next step results in the formation of high and low molecular weight acids; for example, CH_3COOH and $CH_3\ (CH_2)_{12}COOH$.

Let us consider the relative effects of these two types of acid on the neutralization value of the oil in which they are formed.

The neutralization number of an oil is the number of milligrams of potassium hydroxide required to neutralize one gram of oil, and therefore expressive of the total quantity of acidic compounds in the oil without regard to the nature and proportion of these acidic compounds. The reactions taking place in the neutralization of this total acid content by the potassium hydroxide may be disregarded; the combining weights of the reaction, however, is important and are as follows:

56 grams KOH to neutralize 60 grams of CH_3COOH.
56 grams KOH to neutralize 228 grams of $CH_3(CH_2)_{12}COOH$.

By summation, 288 grams of acid require 112 grams of KOH of which, half of the alkali was required for neutralizing 20 per cent of the total acid present. By reason of the much greater activity of this 20 per cent of the total acid, it enters into combination with adjacent metals, particularly in the presence of water, forming salts, and is thus neutralized. It is, therefore, reasonable to conclude that the observed neutralization number given by the usual test method may only show half the amount of acid actually formed, and that the quantity remaining in the oil does not represent any appreciable menace to operation.

The other portion will already have caused its total adverse effect, and in so doing is removed, so its presence cannot be demonstrated by the usual method of analysis used to determine the neutralization value.

These are not the only products of oxidation; oxygen may be added at additional points along the molecular chain, and the final product will be a mixture of acids, alcohols, lactones, ketones, keto-alcohols, and alcohol-acids.

If oxidation occurs in the vapor phase, that is, when conditions are such as to actually cause ebulition of fractions of the petroleum hydrocarbons, it has been found that aldehydes are also formed, which provide the nuclei from which polymerization products arise.

Presented before AISE Annual Convention, Cleveland, Ohio, October 1, 1948

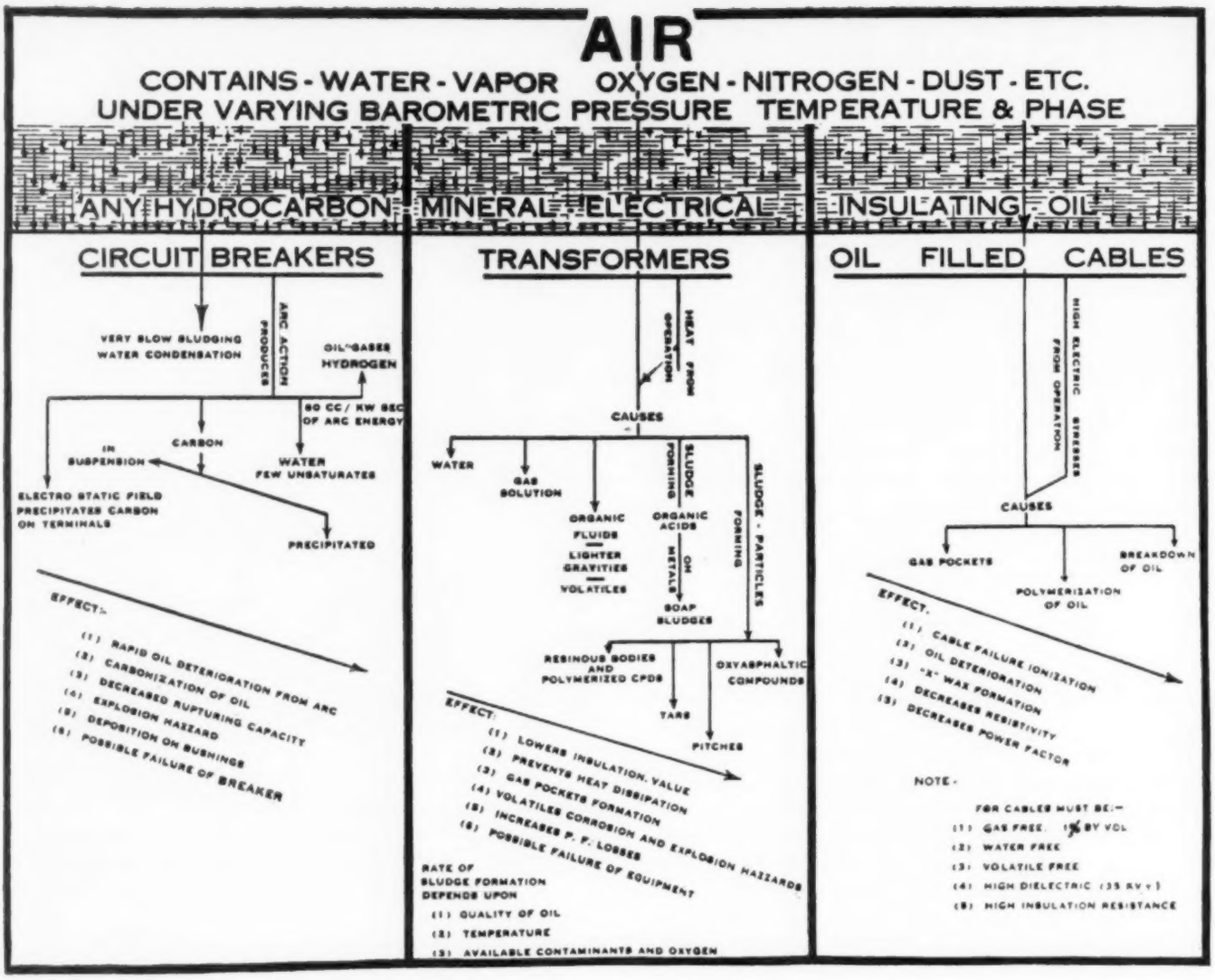


Figure 1 — The chart shows manner in which electrical oils deteriorate with resultant effect on electrical apparatus.

The higher molecular weight carboxylic acids and their derivatives are found to be not only non-corrosive in themselves, but are actually inhibitive of corrosion; a fact which has been of inestimable value to industry, perhaps without any degree of realization or appreciation by industry.

The most important, and most serious effect of the oxidation of petroleum oils, however, is the formation of the low molecular weight acids. Formic and acetic acids, and the corresponding homologs up to nonylic acid are soluble to some degree in water, and it is known that the extent of the corrosiveness of the carboxylic acids is a direct function of their water solubility. However, these acids are of comparatively low boiling point, or easily volatilized, and may be removed by distillation at comparatively low temperature, particularly under high vacuum, and are the products usually classified as the "volatile acids."

POLYMERIZATION

If a petroleum oil contains napthenic or aromatic structures, the advent of oxygen will cause first an aldehyde formation, which is the beginning of polymerization reactions. Since the oxygen of the aldehyde is connected by a double bond to a carbon atom which already possesses a free hydrogen, the tendency to form an alcohol is great when any petroleum oil is oxidized in the vapor phase. If the oxidation still proceeds, this forms an aldehyde of larger molecular weight, which is subject to the same tendency, which results in the production of an even larger molecule. This mechanism can keep recurring until the molecular weight becomes so high that a resin is formed which will be insoluble in the remaining petroleum oil, and will be precipitated as a solid, to clog oil lines or to deposit upon adjacent surfaces. The effect is always accompanied by a lowering of the viscosity of the remaining oil.

SLUDGE FORMATION

The polymerization system just described is not to be confused with the incidence of sludges, a phenomenon which is one of the most obvious of manifestations of oil deterioration. However, it is not feasible to discuss this particular aspect of contamination until some degree of familiarity is achieved with the two pre-

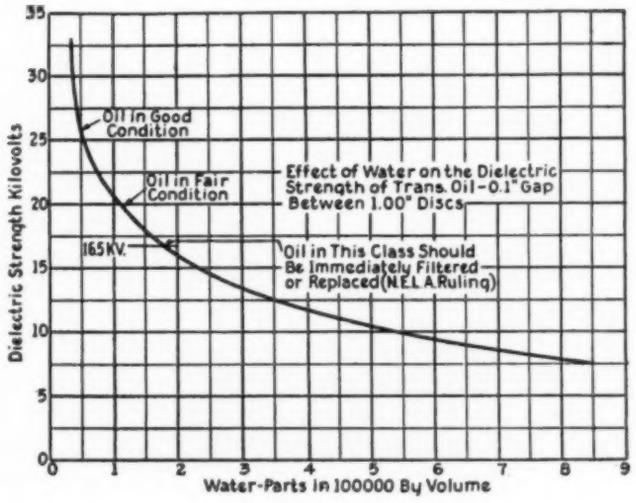
ceding types given above, since both enter into the production of sludges.

It is difficult to give a definition of the term which would completely describe all occurrences, but it is true that sludges are masses of polyphase systems which may occur in petroleum oils after service, characterized by the presence of discrete aggregations, immiscible in the petroleum oil, and possessing well defined boundaries. By the phrase "polyphase systems," is meant complex mixtures of substances foreign to normal petroleum hydrocarbons, even though a proportion have been derived from such hydrocarbons. A typical case of sludge formation would very possibly have a history as follows:

Water vapor oxygen and other gases have had access to the petroleum oil, possibly while the oil was at an elevated temperature. Oxidation of the petroleum proceeds as explained above, to produce the acids, both low molecular weight and high molecular weight. Simultaneously, the water vapor condenses, to form globules of water suspended in the oil. The low molecular weight acids, particularly, are extracted from the oil, to dissolve in the water. The solution of corrosive acids, inevitably come into contact with metal surfaces or with metallic oxides within the system, and as a result chemical combination takes place, with the production of metallic salts of these acids (or more simply, metallic soaps). These metallic soaps are insoluble in the water associated with corrosive acids, and are also insoluble in the petroleum oil. The remaining higher molecular weight acids and other oxidation products, however, have a distinct affinity for these compounds, with the result that these products are withdrawn from solution in the petroleum oil, where they were at least comparatively innocuous, to form an intimate emulsion of water, metallic soaps and petroleum oxidation products. This emulsion will act, by reason of higher viscosity and active structure, as an anchor or nucleus for the deposition of small solid particles such as carbon, and metallic oxides, and will quickly appear as a body which is totally separate from the surrounding petroleum oil and is called sludge.

It will be readily seen that the process of formation is continuous, the rate principally depending on the rate of oxidation of the petroleum oil, the sensitivity of adjacent metal surfaces, the presence of metallic oxides, and the incidence of water. Many other effects can enter into this process of sludge formation, for example, catalytic effects. It is not possible to present a complete list of all factors, since practically each case would require individual study. The mechanism described above may, however, be regarded as a typical illustration.

Figure 2 — Effect of water on dielectric strength of transformer oil.



SERVICE EFFECTS OF OIL CONTAMINATION

One of the most valuable properties of the hydrocarbons is that they are nearly perfect non-conductors of electricity. Consequently, the use of properly refined petroleum fractions in electrical apparatus is widespread. They are used in transformers, circuit breakers, and switches and in certain types of power transmission equipment. It has been established that the presence in solution of oxidation products results in a decrease in dielectric strength approximately paralleling the increase in concentration of the dissolved substances. In addition, interruptions in the continuity of the dielectric due to presence of suspensions of water, sludge, resinous compounds, or gaseous dispersions are effective in diminishing the heat dissipation characteristic of the petroleum medium. The oxidation processes follow the same paths as described previously, and activation by electrical energy is as effective as that by pressure-temperature relationships as experienced in mechanical mechanisms. The deposition of resinous compounds upon the cores and windings of transformers not only prevents adequate heat transfer through the oil, but also with free circulation of the oil. The degree of contamination of oil used in the electrical industry will therefore be understood to be very definitely more critical than in most other applications, while the nature of the contaminating substances is identical. If the oil ceases to function as a dielectric, while electrical energy is still being utilized, the final physical effects on the equipment involved can be much more damaging than those usually occurring in mechanical equipment exposed to contaminated oil. The industry, recognizing this, is much more careful of the quality of the oil in service than most others.

IDEAL SOLUTION TO THE PROBLEM

It is an aphorism that the perfect solution to a problem is to refuse to permit the conditions creating it to exist. This state of affairs is seldom realizable in commercial operation, and consequently more effort is usually directed toward diminution of adverse effects that is spent profitably to eliminate them. Several objectives seem to be reasonably indicated, and may be expressed thus:

1. The oil selected should be the most stable and oxidation-resistant which is available or can be developed.
2. Conditions of operation and design should be so controlled that the operation of the electrical de-

vice should not give rise to, or promote, changes in the composition or constitution of the oil employed, this to be achieved without sacrificing the efficiency.

3. Means also should be provided for the removal of the external agents such as air, water, or other products entering into, or necessary for the undesirable chemical changes. By removing these substances, no possibility can arise of the critical concentration of these agents being allowed to develop, that is, a concentration in which combination with the petroleum hydrocarbons can be initiated.

When an oil is used for any specific application other than as a fuel, it can well be visualized that the ability to maintain the oil totally free from impurities and contaminating substances will extend its usefulness beyond the period usually accepted as pertaining to that application.

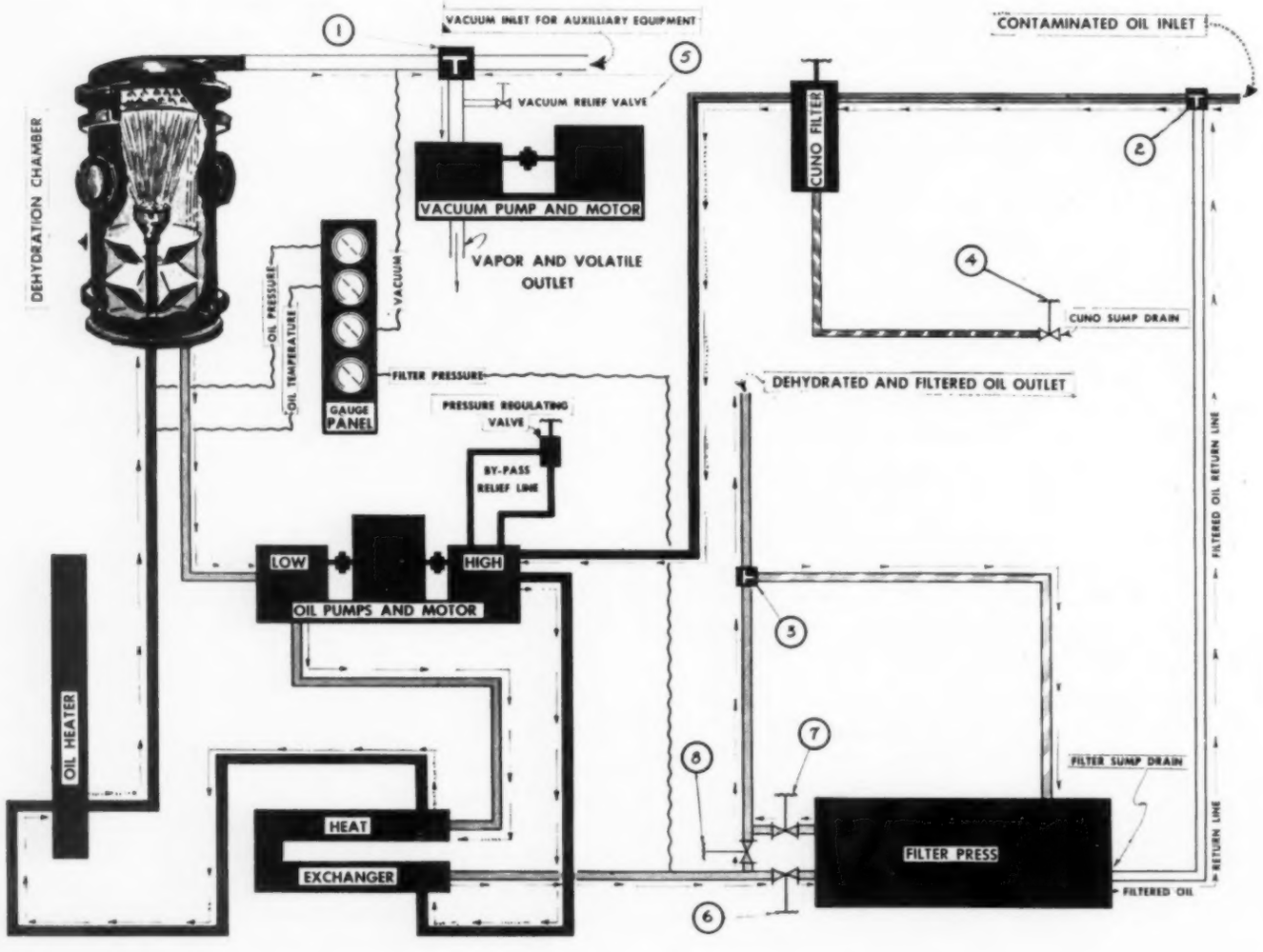
Exclusion of solid impurities is feasible by means of filtration, and the removal of liquids present in a separate phase can sometimes be attained by gravitational separation employing the laws of physics, especially Stokes' law. Where external liquids are present in dispersed phases, particularly in dispersions of individual liquid particles of dimensions falling within the colloidal range, gravitational separation methods must be necessarily insufficient to remove all of the liquids present in phases external to the principal phase, that is, to the oil being treated.

Again, if the applications be of such a nature that it is possible for oxidation mechanisms to develop, intersolubility relationships are set up, frequently accompanied by an intermediate phase, attempts to achieve complete separation by gravitational or centrifugal actions are incomplete or accomplished with excessive loss of the oil being treated.

The author has been applying a process developed for the single purpose of freeing easily and completely electrical oils, used in circuit breakers and transformers, from dissolved or dispersed gases and low molecular weight liquids. The principles involved in the process are fundamental and because of this, a clear picture of the process may be readily drawn.

When oil or other liquid is exposed to the action of heat energy and reduced pressure or vacuum, removal of gases and volatile acids, will be effected by a partial fractional distillation. The effectiveness of this phenomenon will be dependent upon the temperature to which the oil is heated, the time of exposure to the joint actions, and the volume and relative surface area of the liquid exposed.

Figure 3 — Schematic flow diagram showing removal of impurities from electrical oils.



It would clearly be impractical to have a comparatively large volume of oil contained in a narrow vessel, and to heat the oil and to create a high vacuum above the surface of the oil in the vessel. The efficiency of the system would improve as the surface area was increased and the depth of the oil decreased, and thus improvement would persist until the final limit was reached; that is, until a film of negligible thickness was exposed to the joint actions of heat and vacuum. At this stage, it is possible to separate the contaminating agents described with a degree of completeness far beyond that obtainable by means of gravity, separation means, either centrifugal or static.

A modification of this film extension method has been employed by many utilities and transformer manufacturers for several years with signal success for the preventive maintenance of electrical oils.

Following the reasoning disclosed, further extension of the ratio of surface area to volume or mass of the oil should give a proportionate increase in efficiency. This has been accomplished by causing the oil to be presented in very small particles in the form of a spray, so that the surface of the spheroids so formed is presented to the vacuum at a temperature sufficient to cause volatilization of the most undesirable dissolved contaminants, specifically corrosive acids, water, and oxygen. The dehydrated and degasified oil is then passed through a conventional filter press. By virtue of the fact that no water, either free or in solution, is present, a degree of mechanical filtration is possible that far exceeds that obtainable where a conventional press alone is used for dehydration. Since the paper is not used to absorb water, the paper does not swell and allow colloidal particles to pass through the filtering medium. The useful life of the filtration medium is, therefore, only dependent upon the amount of solid material removed and is, therefore, extended.

A comparative test was run at a chemical plant to determine the efficiency between a conventional filter press and a press preceded by a vacuum dehydration unit. The transformers selected held 300 gallons of oil. Both had been subjected to identical service conditions. The oil was found to have a dielectric strength of 15 kv.

With the conventional blotter press of 300 gphr capacity, a total of 16 hours of recirculation was required to bring the dielectric strength to 25 kv and during this time 500 sheets of filter paper were required. No reduction in the neutralization number was noted.

With a combination vacuum dehydration unit and filter of 100 gphr capacity, the dielectric was restored to 35 kv in 3 hours and the original charge of paper in the filter, still in use, was used subsequently to clean six additional transformers. The neutralization number was reduced from 0.252 milligrams KOH per gram of oil to 0.168 milligrams KOH per gram of oil. This was due to the reduction of the volatile acid content to zero.

The reasoning followed, that oils treated periodically to remove the causes of oil degradation would withstand service conditions over long periods of time, has been proven to be valid. It has been possible to maintain transformer and circuit breaker oils in operating condition for longer periods of time than has previously been possible. This has also reflected itself by

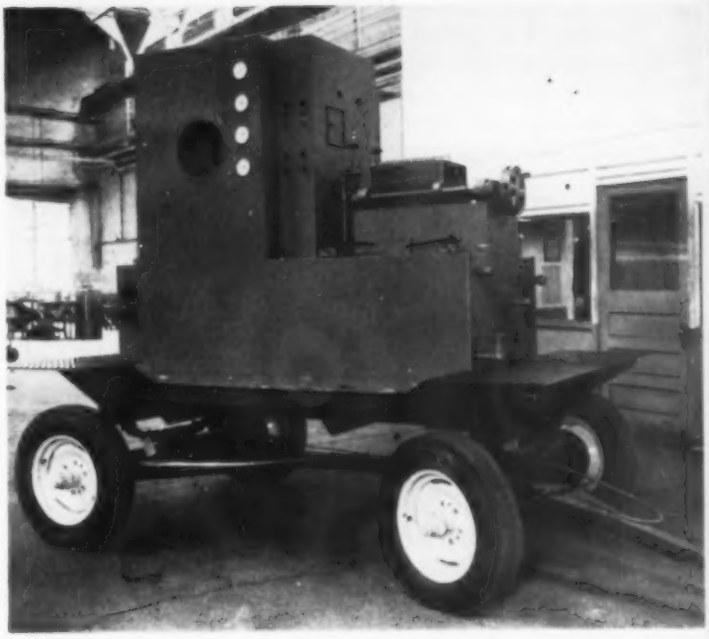


Figure 4 — Portable unit for cleaning electrical oils.

the number of transformer failures due to contaminated oil. Of thirty users of this method of preventive maintenance surveyed, none have had any failures due to contaminated oil since the installation of this process. Dielectrics have been maintained high and neutralization numbers have been stabilized and in some cases gradually reduced.

The preventive maintenance of these transformers has been accomplished while the transformers were energized, thus eliminating the need for taking the transformers out of service. This enabled the work to be done when convenient. The maintenance crew has been able to work on any given transformer at any time and did not have to wait until a no load or low load period. The necessity of removing the oil and returning it to a central point for re-refining with fullers earth or by chemical treatment has been eliminated. It can also be expected that within a very few years the oil companies will develop electrical oils containing inhibitors or additives. Any earth treatment would remove these inhibitors, and make such a process inoperative.

Preventive maintenance of oils, not reclamation, has proven to be the least expensive, not only from the cost of oil replacement but, also, from the hidden savings due to decreased equipment failure. To maintain an oil in operating condition by the methods described costs less than one cent per gallon. To reclaim an oil costs nine cents or better without taking into consideration the cost of transportation charges to a central piece of equipment.

Each and every operator of electrical equipment that requires the use of electrical oils should survey his immediate problems and then set about to install the necessary mechanism for preventive maintenance.

A rigid program of oil inspection to determine how often each transformer should be treated with portable equipment plus periodic treatment to prevent excessive contamination is a good investment. Dielectrics should be kept at all times above 25 kv, and water soluble acid content should be kept as close to zero as

possible. The rate of contamination is slow at first but increases rapidly with time. By removing the cause at the beginning or as soon as practical, the effect will be removed. Recently, the author had an occasion to be called upon for a conference concerning a bank of three transformers, one of which had been lost due to oil failure. Each of these transformers contained 700 gallons of oil. The terminal boards and bottom were covered with sludge and the oil circulation ducts plugged.

To replace this oil at present day prices cost $735.00. This oil could have been maintained (on a two-year-treating schedule) free of sludge, oxygen, and corrosive acids for $21.00. The savings in oil alone would have been $714.00, but what is more important is that the cost of rewinding and repairing the one transformer and the cost of dismantling and cleaning the other two would have been eliminated.

For management to permit such wastes certainly is not good business practice and for engineers to permit such neglect is certainly not becoming to their profession.

DISCUSSION

PRESENTED BY

R. A. KRAUS, General Millwright Foreman, Republic Steel Corp., Chicago, Ill.

W. A. SMILEY, Electrical Engineer, Bethlehem Steel Co., Steelton, Pa.

E. TAYLOR, General Electrical Foreman, Atlas Steels, Ltd., Welland, Ontario, Canada

G. R. WALTER, Chief Electrician, American Smelting & Refining Co., Baltimore, Md.

A. CICHELLI, Lubricating Engineer, Bethlehem Steel Co., Sparrows Point, Md.

C. J. EGGER, Bowser, Inc., Fort Wayne, Ind.

R. A. Kraus: Regarding the use of inhibited oils for hydraulic mediums and for transformer applications as mentioned in your paper, the difficulty in filtering these is at hand, since each day results in greater use of this type of product for these purposes. As you mentioned, the fuller's earth method of reclamation is not feasible and consequently, other means of reclamation must be found. Vacuum dehydration apparently is an answer.

I would like to take this opportunity to reopen a discussion that was started at a previous meeting regarding the advisability of attempting to reclaim transformer oils. At that meeting there apparently were some in attendance who did not feel that it was worthwhile to reclaim transformer oil. The thought was expressed that, independent of the methods used for reclamation, the resultant material was unsatisfactory from the standpoint of expected life or dielectric strength. There are some of us who do not concur with this expressed opinion, particularly in view of the increased cost of new replacement transformer oil. I would like to hear Mr. Egger's comments on this matter.

Wm. A. Smiley: Of the extremely few constructive approaches to the problem of transformer maintenance, the method described by the author seems, on the basis of past performances, to offer the least involved solution to the problem.

Mr. Egger has pointed out the general lack of understanding of the complex chemistry of insulating oil in contact with metals, insulation, water and oxygen.

This condition has resulted in the search for an apparatus through which oil may be passed so that sludge, soaps, dissolved insulation, varnish, water and acids may be removed from the oil, and from the transformer as well, with the result that the unit and its contents are returned to an "as new" condition.

Where large quantities of oil are to be re-refined, and the operation is under laboratory control with competent full time technical supervision, the operation may be justified under some circumstances, particularly when cost is offset by the advantage of using re-refined oil in an old transformer.

The portable adsorbent type filter has attracted some attention and we would appreciate any comments the author may care to make regarding this small scale device for partially re-refining of oil.

In connection with the rather prevalent attempts to prolong transformer life by removing the old highly acid oil and replacing it with new oil, it has been our observation that the new oil promptly becomes acidic and sludge forms. We should like to ask the author whether our experience is an exception, or whether this reaction is general in nature.

Inasmuch as various inhibitors cause sludge formation when added to oils with neutralization numbers of the order of 0.10 and greater, we would like to know if it is the natural (or added) inhibitor in new oil which causes the reaction we have mentioned. We have never observed sludge formation when used oil is added to other used oil of the same type.

Eric Taylor: We run a fairly large electric furnace plant and have at the present time approximately 25,000 gals of transformer oil which is suspect, to say the least.

Over the years we have been religiously using centrifuges and filter presses and thought we were perfectly all right until about six months ago when we had reason to have a transformer overhauled. It had not broken down, but we wanted to load it a little heavier than it was already loaded, and wished to have it put into first class condition, by the manufacturer for that reason.

Upon checking the manufacturer was very much alarmed, and frankly we had not known about this acidity trouble. We also made inquiries among our neighbors on this side of the border, as well as in Canada, but discovered that almost no-one else knew anything about it either. Of course we all knew what it meant, knew what it would do, etc, but everybody seemed to consider that filtration and the use of the centrifuges was all that was required.

The problem then arose as what to do. Our Canadian oil companies, two of them at least, are very well equipped, but they gave us a statement that frankly there was nothing they could do. They could bring the acidity down to the proper value, but it would not stay there. In three months it would be bad again and they did not want to touch it.

I do not know how you gentlemen are situated in this country, but in Canada this type of oil is not easy to get.

G. R. Walter: We have had about six years experience with this insulating oil maintenance equipment, all of which has been quite satisfactory. Prior to this time, we were using the conventional centrifugal dehydrator and were dehydrating the oil in our rotary converter transformers on the average of about once every twelve months. We were removing the core and cooling coils on the average of once every two years for sludge removal. (All of these transformers are of the free breathing type.) This frequent repetitive maintenance was not done by reason of a planned schedule, on the contrary, it was forced upon us due to excessive transformer operating temperatures caused by oil sludge deposits on the cooling coils, winding ducts and tank interiors retarding effective oil circulation, cooling and radiation.

The average oil neutralization number of six of these transformers was 1.83. The maximum was 3.00 and the minimum 1.17. In connection with these neutralization numbers, I might add that there are two additional duplicate spare units, either of which are used when any one of the other six are taken out of service for brush maintenance, cleaning, etc. The neutralization numbers of these oils were 0.65 and 0.70, respectively. This bears out the deleterious effect of wide range temperature changes on insulating oil in free breathing transformers. The oils in all eight units were of the same age.

Before applying this new oil maintenance process, all eight units were detanked, and visible sludge removed. Each core assembly was flushed with approximately 100 gallons of new oil to dissolve, as much as possible, inaccessible sludge trapped in windings, ducts, core, etc. In connection with this flushing procedure, we are of the opinion that if the core assemblies were allowed to remain submerged in new oil for several weeks, a more effective sludge dissolving job would be obtained; this oil could again be used on other core assemblies until its saturation reached the point where it became ineffective for the purpose and would have to be discarded. The economics of this procedure, however, requires careful consideration where large quantities of oil are involved. The cleaned core assemblies were replaced and the tank filled with new oil which was passed through the new dehydrating and filtering process.

On completing all weight units according to the method outlined, the average neutralization number was 0. 047. The maximum of these was 0.1 and the minimum, 0.025. All the new oil was checked and found to have a neutralization number of 0.000. These oils after five years of service show an average neutralization number of 0.192, with a maximum of 0.324 and a minimum of 0.175. The most rapid neutralization number increase took place during the first year. This indicates the residual sludge remaining in the core assembly was further dissolved during this period as all subsequent checks show a decided slower rise.

We believe this rise rate could be retarded by increasing the reprocessing schedule. That is to say, the more often you reprocess, the lower you will hold the acid number.

We have found that after each reprocessing the acid number was slightly lower than before, which in our opinion demonstrates the effectiveness of the process as it was not expected to lower. We have on several occasions reprocessed oils in 13 kv transformers while in service as there is no aeration, there are no air bubbles to worry about.

Our discarded oils were disposed of through the regular plant liquid fuel system.

A. Cichelli: I gather there are two sides to this problem. One of them is to prevent the oil from ever getting any worse. Someone else discussed the problem of reducing the neutralization number by reclamation.

I do not think that Mr. Egger at all claimed in his paper that he would reduce the neutralization number. Am I right?

C. J. Egger: We do not claim it, but it has been done.

Member: I had a little experience in a B-29 aircraft engine plant during the war. Before those engines were released they were run through a five-hour shakedown test. At the end of those five hours there were eight or 10 gallons of oil drained out, and we used to accumulate 30,000-40,000 gallons a month of this break-in oil.

With a reclamation system we had, or maybe I should say re-refining system, we were able to get the acidities, which at the end of a five-hour run would be up around 0.3, 0.4, maybe 0.5, and which approached 1.0 in some 100-hour runs approaching one, down to double 0, maybe 0.01.

We submitted samples to Wright Field at Dayton, Ohio. The Army Air Forces said, "Well, you go ahead and add 20 per cent of this re-refined oil to the new oil you are getting in." We reached the point there where the Army Air Forces at Dayton allowed us to use 100 per cent re-refined oil to break in those B-29 engines.

I was wondering if an actual re-refining unit could not be used on these transformer oils?

A. Cichelli: I suppose it depends on whether you can remove the oil from the transformer.

C. J. Egger: Taking Mr. Kraus' first question in regard to reclamation of transformer oils, my company has manufactured reclamation equipment for transformer oils for quite some time. However, I would like to distinguish between reclamation and maintenance.

Maintenance of the oil is the ideal solution, but there is much oil in transformers and in drums today that has deteriorated so far that it cannot be maintained. Its service life is nil as it stands. That oil can be re-reclaimed or re-refined, but in re-refining an oil, especially a transformer oil, extreme care must be taken to see that the neutralization number is not brought back to the original "neut" number.

We have seen occasions where that has happened, and the service life of the oil has been decreased considerably. On the other hand, if that oil is reclaimed and brought back to a neutralization of about 0.01 rather than 0.0001, the life of that oil will be comparative to new oil. Then if that oil, after it has been put in a clean transformer, is maintained with portable equipment, the life of the oil in that transformer will be extended beyond periods that are obtainable today.

One of the chief troubles in the utility field today is that so many people have neglected their oils. They have not done anything with them, and they have not even used equipment that they have had on hand. I

have seen instances where operators have had transformers for over 20 years and have not even used available oil maintenance equipment.

Taking Mr. Smiley's question in regard to the solubility of insulation, we have recently run some corrosion tests on oils that had neutralization numbers in the neighborhood of 1.6 and have run them through equipment with vacuum dehydration. As I said before, we do not claim to reduce the neutralization numbers. We had a very slight reduction, but that reduction on an exceedingly dark oil is hard to determine because it is hard to determine the end point of that oil. It was oil from old transformers, and the varnish that they used in those days dissolved in the oil, giving it a reddish color. The end point on titration is pink, so it is hard to distinguish it unless you take extreme care, and then it is not accurate.

This oil had a neutralization number of around 1.6. We then subjected the untreated oil and the treated oil to corrosion tests on all types of metals and gasket material. We found there was much less corrosion with the treated oil than there was with the new oil.

The cork gasket material completely disintegrated in the presence of untreated oil, and in the presence of treated oil it held its original shape. I think that will give some bearing on the solubility of insulation and materials that are used in transformers in regard to neutralization number.

One thing that I would like to bring out is that there is a difference in the acid compounds that are present in oils. The higher molecular weight acids are actually inhibitors, they do not actually harm the oil, but the low molecular acids will attack metal surfaces and other materials and cause a great deal of damage. They also act as carriers for electricity because they will ionize. They are highly conductive and therefore reduce the dielectic strength.

A member asked if this application could be used for lubricating oils. We have used this same method of treatment for turbine oils for a number of years and have found that if vacuum dehydration equipment is operated the majority of the time that the turbine is operated, the neutralization value of the oil in that turbine will be stabilized. We do not claim to reduce it. However, there are instances where it has been done. Over a long period of time, the neutralization number of that oil will be stabilized because we are continually taking out the chief offender as far as oil contamination is concerned, that is, oxygen. In order to have an acid built up in an oil, you must have oxygen present. The acid build-up is due to oxidation of the oil.

Mr. Taylor brought up the question in regard to acid values. I have seen transformers that have been in operation for a number of years that have had neutralization values up as high as 2.0 and 2.5 and these transformers are still in operation with neutralization numbers of this magnitude.

That transformer was taken out of service and completely cleaned of sludge.

Oil treated by the vacuum dehydration process to remove all corrosive acids was put back into this transformer, and there has been no additional sludge noticed in this transformer.

If the oil goes to a point where the neutralization number rises as high as five, and there are plenty of cases where oils have been in service up to that point, it can be re-refined safely and put back into the transformer, but care must be taken not to over-refine that oil.

I wish to thank Mr. Walter for his very welcome comments. I do not believe I have anything to add to them. I would like to ask Mr. Walter, though, if he has any idea what his average neutralization values are today?

G. R. Walter: About 0.025. Incidentally, we burned all of our old transformer oil. We took all the old oil and burned it and replaced all the oil. We have found that it was cheaper to buy new oil than it was to attempt to have this oil re-refined.

C. J. Egger: That is the thing that actually I was trying to bring out in this paper today, and that is to put good oil in your transformers first of all, and then maintain it. In this way you can operate another 20 years without having the same situation arise as you have today.

Recently I talked to one of the utilities in Chicago, and they have had no reclamation process to date. However, they have been watching their transformers very carefully and taking periodic samples about every three months. Their reasoning behind not having any maintenance equipment was that they had a great number of oil burners. They would take their oil out of service when the neutralization number got to a predetermined value and use it as a fuel oil. They said this was cheaper than to bring the oil back to some central point for servicing. They have noticed over a period of 20 years that each time new oil was put in these transformers that the life of that new oil was considerably shorter, and they finally reached a point on some transformers (where the original life span of that oil may have been 10 years), where it gradually had reduced itself down in some cases to the point where the life of new oil is only six months. This has been caused by letting this oil deteriorate to the point where it has to be thrown away instead of practicing preventive maintenance.

That indicates that they have left something in that transformer which they did not get out when they just drained the transformer. Therefore, it is not economical to replace that oil every six months.

They are going to have to do something about it, either have some type of maintenance equipment or else get rid of those transformers, because the use of new oil every six months is a rather expensive proposition.

In regard to the use of reclaimed motor oil, there was a similar installation at Wright Aeronautical. All the oils that were used in the run-in of engines made at Wright Aeronautical were lubricated with re-refined oil, and the oil company supplying the new oil went so far as to furnish to the user of the oil the inhibitors to put back in the oil. You can use re-refined motor oil.

Member: B-29 engine oil specifications were different. Maybe you have something different in mind.

C. J. Egger: It may be, but I do know they did re-refine engine break-in oil during the war at Wright Aeronautical. Of course, when they were running a lot of engines in a test block, it was a rather serious problem to know what to do with all this used oil.

In the case of used motor oil it is a problem of disposal as well as a problem of saving money.

NICKEL-CADMIUM BATTERIES

. . . . long known in Europe, the nickel-cadmium battery has only been recently introduced in the United States where it offers unusual possibilities for many applications . . . .

By C. BERG
Chief Engineer
Nickel Cadmium Battery Corp.
East Hampton, Mass.

▲ LEAD-ACID and nickel-iron-alkaline batteries have been manufactured and used on a very large scale in this country for many years and their characteristics are therefore well known among engineers.

Although the production of nickel-cadmium batteries is a relatively new industry in this country, such batteries have been manufactured continuously for some 40 years abroad where they have gained wide acceptance and their characteristics are well understood.

The "nickel cadmium" is an alkaline type of secondary, i.e., storage battery, and as the name implies, the chief electrochemically active materials are compounds of nickel and cadmium operating in an alkaline, not acid, electrolyte. The purely mechanical structure of the cell is made of nickel plated steel, and it is common practice to furnish the cells mounted in wooden trays to make up batteries of the desired voltage. At present, cells are manufactured in various sizes from 10 to 600 ampere-hours.

The positive and negative plates are of the same mechanical design and external appearance. The active materials cannot be made to form hard-setting cements in the electrolyte, and can therefore not be pasted onto plate grids. For this reason they are manufactured in powder form and introduced under very high pressure into flat tubes or so-called pockets having a rectangular cross section of approximately $\frac{1}{2}$ x $\frac{1}{16}$ in.

The pockets are made of two opposed 0.004 in. thick, very finely perforated and subsequently nickel plated steel strips seamed along their edges and shaped so as to form a receptacle or envelope for the active material.

The perforations are 0.006 in. diameter lanced holes mutually pitched at 0.020 in. and allow the electrolyte to enter the pocket and react with the active materials.

The hole diameters, the hole crater resulting from the lancing operation, the particle size of the active material and the pressures employed in the manufacture and maintained during the chemical reactions of the active materials in service are so arranged that the active materials cannot escape even under the most violent gassing, and hence no mud space is required in the cells.

Presented before AISE Cleveland District Section Meeting, March 21, 1949; the Youngstown District Section Meeting, March 22, 1949, and the AISE Pittsburgh District Section Meeting, April 11, 1949

The filled pockets are mounted horizontally and under great pressure in plate frames of nickel plated steel and provided with lugs by means of which the plates are assembled into groups and to their respective posts.

The plates are separated mechanically and insulated electrically from each other by polystyrene rods resting in vertical grooves in the plate faces and from the cell jar, made of nickel plated sheet steel, by hard rubber sheets.

The use of steel as a structural material makes it possible to work to very close tolerances and the completed cell is mechanically a very robust unit.

The posts are made of steel and pass through liquid-tight insulating glands in the cell lid which is also provided with a filler opening covered by a hinged type cap. The posts are threaded and carry two nuts clamping a flat strap-type nickel plated copper inter-cell connector. Individual cells or trays can hence easily be added to or removed from the circuit if required without special tools.

The cell jars are provided with steel bosses on their sides which engage hard rubber cups let into the sides of the tray in such a manner as to hold the cells suspended in mid-air, air being thus used as inter-cell insulation.

For small stationary applications, the battery trays are generally placed directly on the floor or on a wall shelf. Very large cells are commonly erected individually on insulating pallets or racks. Where a dry and clean location is available, there is a growing tendency in the case of medium-sized stationary batteries to dispense with racks and to modify the trays so as to enable them to be placed directly on the floor.

Although certain standard sizes are offered, the mechanical design of the plates makes it possible to produce readily plates and hence cells and complete batteries of practically any reasonable shape for a given capacity and voltage without special tooling.

The electrochemically active material in the positive plates is nickelic hydroxide, $Ni(OH)_3$. This compound is a very poor electrical conductor and 25 per cent by weight of high purity specially treated graphite is added to obtain the required conductivity.

The active material in the negative plates is cadmium, CdO. On charge this is reduced to finely divided metallic cadmium and in order to overcome its tendency to coagulate or sinter, about 30 per cent by weight

of Fe_2O_3, ferric trioxide, is incorporated with the cadmium oxide by a special process.

The electrolyte consists of a solution of caustic potash, KOH, in distilled water.

Although considerable research has been done on the reactions which occur in the nickel cadmium cell, its electrochemistry is only partly understood.

The electrolyte, both on charge and discharge, is constantly broken up and reformed to its original quantity indicating that it does not combine to form any permanent compound with the active materials. Its specific gravity hence remains constant during any given cycle of charge or discharge.

The graphite in the positive, and the ferric trioxide in the negative plates take no part in the reactions.

For practical purposes the following formulae may serve to illustrate the chemistry of the cell:

Charge

Positive

$$2Ni(OH)_2 + 2OH = 2Ni(OH)_3$$

Negative

$$CdO + H_2O + 2K = Cd + 2\,KOH$$

Discharge

Positive

$$2Ni(OH)_3 + 2K = 2Ni(OH)_2 + 2KOH$$

Negative

$$Cd + 2OH = CdO + H_2O$$

or

$$NiO + CdO = NiO_2 + Cd$$

The chemistry of the nickel cadmium cell confers upon it the following characteristics:

1. The chemical reactions are perfectly reversible.
2. The active materials are insoluble in the electrolyte.
3. The active materials cannot react with the electrolyte when the battery is on open circuit.
4. The specific gravity of the electrolyte does not change through a complete cycle of charge and discharge.
5. As long as the plates are covered by the electrolyte, the capacity of the cell is independent of the quantity of electrolyte present in the cell.
6. Cadmium oxide will reduce to cadmium at a voltage less than 1.47v, the dissociation voltage of the electrolyte but above 1.33v, the open circuit voltage of the cell; hence the cell can theoretically be fully charged without gassing provided the charge period can be suitably extended.
7. The cell does not gas on discharge.

The practical implications of the above are the following; each of the following paragraphs are numbered to correspond with numbers of previous paragraphs:

1. The nickel cadmium is a secondary, not a primary, cell.
2. No open circuit reaction similar to sulfation in lead batteries can occur.
3. Oxides and hydroxides of nickel, cadmium and iron, if entirely free from all impurities, are completely inert when used as anodes or cathodes in KOH solution. Cells made of such materials would have no self-discharge but would be prohibitive in price and have very few and limited applications. A happy medium has therefore to be struck between manufacturing cost, permissible magnitudes of impurities and open circuit self-discharge characteristics. The rate of self-discharge of new batteries is rather high compared to batteries which have been in service 6 to 12 months. On such batteries the rate of internal self-discharge is about 25 per cent per annum of available capacity.

As in other types of storage batteries, considerable external self-discharge can take place if the battery is in a dirty condition, particularly if stored in humid surroundings.

The graphite in the positive active material appears in general to be slowly soluble in the electrolyte and hence to govern the length of life obtainable from the battery under different service conditions.

4. This characteristic prevents the use of the specific gravity of the electrolyte to indicate the state of charge. The state of charge of nickel cadmium batteries is generally ascertained by taking simultaneous voltage and current readings.

This enables the quantity of electrolyte to be reduced to a minimum and the plates to be placed very close together, i.e., about $\frac{1}{32}$ in. apart. By this means and the use of thin plates the internal resistance is brought down to values which enable the battery to be used for high rate discharge applications, such as switch closing and engine starting.

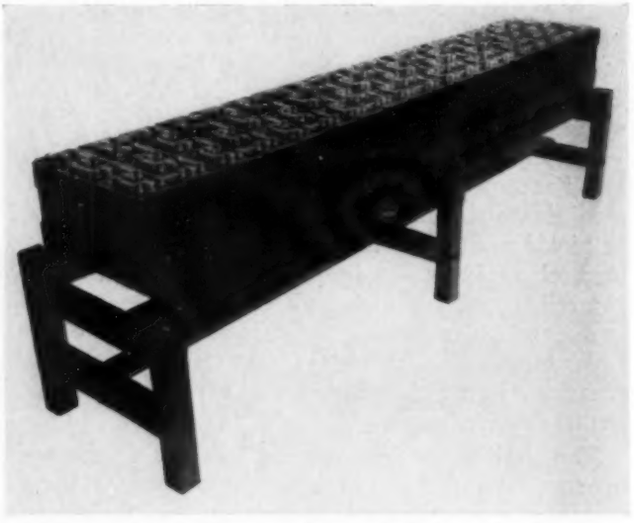


Figure 1 — This station control battery is a 120-v, 95-cell, 65 ampere-hour (5 hr rate) battery assembled in nineteen 5-cell trays. Overall dimensions are 24¾ in. wide, 32¼ in. high, by 8 ft 10 in. long.

6. On a normal, 7-hour, constant current charge the cell will reach a voltage of 1.47v after about 4½ hours have elapsed. The final charge voltage at the 7-hour rate is 1.75v. Between 1.55v and 1.75v, the cell gases quite freely.

The bulk of nickel cadmium batteries are, however, used with charge voltage regulated equipment having the same characteristics and settings as used for lead batteries. Under these conditions an individual cell charge voltage of 1.40-1.50v is rarely exceeded and the flushing periods consequently considerably prolonged.

Experience has shown for instance that bus batteries require watering about every three months, diesel locomotive batteries every six months and station control batteries every twelve months.

The open circuit voltage of a fully charged cell at normal temperature is 1.33v. The cells are generally floated at 1.36-1.37v and trickle charged at 1.38-1.40v.

7. This feature enables the cells to be hermetically sealed if required on discharge, an advantage with small portable batteries.

The gases evolved by the nickel cadmium battery on charge are hydrogen and oxygen the same as all other storage batteries and of course just as explosive.

The spray given off when the cells are gassing freely is not corrosive to normal structural materials such as steel, wood and concrete or to any parts of the battery itself.

In most applications, however, the cells hardly ever gas as the charge voltage is below the 1.47v gassing voltage, and the batteries may consequently be placed quite close to instruments and other similar apparatus without fear of corrosion.

The caustic potash electrolyte will absorb carbonic acid, CO_2, from the atmosphere to form potassium carbonate, K_2CO_3, which is freely soluble in the electrolyte but increases its resistivity and consequently the internal resistance of the cell, thereby reducing the available ampere-hour capacity without apparently affecting the ability of the battery to furnish momentary heavy discharge currents as required in engine starting or switch closing, for example.

In order to seal off the electrolyte from the air it is common practice on stationary and large mobile batteries (diesel locomotive, for example) to float a layer of pure, non-saponifying acid-free mineral oil on top of the electrolyte which varies in depth from ¼ in. for small cells up to ¾ in. for very large cells. It is also good practice not to open or keep open the cell vent caps unnecessarily.

The normal specific gravity of the electrolyte is 1.190 with permissible variation of from 1.170 to 1.230.

At normal temperature the battery will grow sluggish if the specific gravity exceeds 1.250 and will be damaged if the specific gravity is permitted to fall below 1.150.

Where the battery is to be used permanently at low temperatures, better results will be obtained if the specific gravity is raised to 1.280-1.300.

The average discharge voltage at normal rates of discharge is 1.20v and the final discharge voltage 1.10v.

A 120-volt battery floating at 129v and with a permissible end voltage of 105v would consist of 95 cells, as a rule put up in 19 five-cell trays.

Switch tripping batteries of 48 volts generally comprise 37 cells. Other representative cell numbers are 48 cells for 64v and 88 cells for 110v diesel locomotive starting.

Diesel engine buses use 10 cells for 12v starters.

For gasoline engined city buses 9 cells are used and for intercity buses 10 cells.

The ampere-hour efficiency of the nickel cadmium at normal rates of charge and discharge is about 75-80 per cent, and the watt-hour efficiency 60-65 per cent.

Overcharging has no harmful effect and this feature is of particular value in trickle-charge applications.

As a rule, the battery should not be discharged at normal rates below 1.00v per cell, and while deep discharges at heavy rates, as common in engine starting

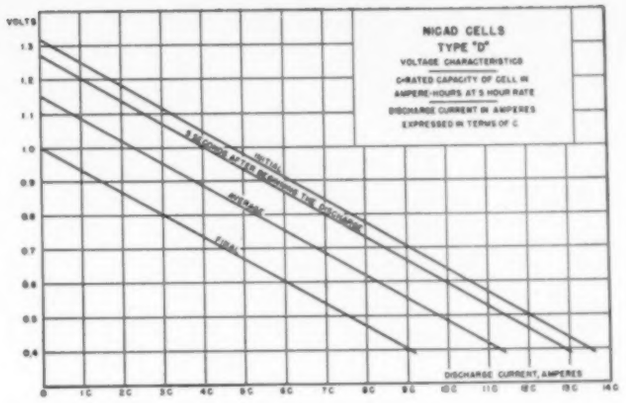


Figure 2 — Relationship of voltage to discharge current of type D nickel-cadmium battery.

for instance, will not damage the battery, repeated over-discharges, particularly at low rates, will reduce its capacity.

Owing to their longer life a smaller factor to allow for loss of capacity due to aging is generally applied to nickel cadmium batteries, and it is therefore common practice to install batteries of smaller initial ampere-hour capacity than required for lead batteries.

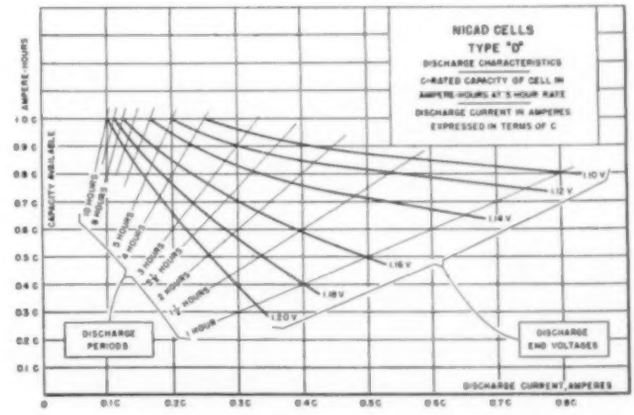
The maintenance of nickel cadmium batteries is relatively simple and consists in effect of keeping the cells and the trays reasonably clean and dry to prevent external corrosion of the cell jars through electrolysis, checking the specific gravity, and adding water occasionally so as to maintain the electrolyte level above the tops of the plates.

Batteries which are charged by the constant current method, at such heavy rates as to cause them to gas freely and thus require frequent watering necessitating the opening of the vent caps, may have to have the electrolyte changed every 4-5 years in order to prevent excessive accumulation of potassium carbonate.

On stationary batteries, however, particularly those on trickle charge or float, or where a charge voltage of 1.50v per cell is rarely exceeded with attendant small water consumption, the electrolyte is not changed throughout the life of the battery.

Permanent damage is done if the battery is operated above 145 F. Above 115 F, heavy charge currents, i. e.,

Figure 3 — Relationship of discharge current to available capacity for type D nickel-cadmium battery.



two to three times normal, will raise the electrolyte temperature rather rapidly, and this must be considered when contemplating installations in locations having a high ambient temperature.

The capacity available is reduced at low temperatures. Experience so far of batteries working in this country indicates that down to — 20 F the capacity and engine starting ability are for practical purposes unaffected, but that for services at — 20 F to — 40 F a somewhat larger battery is required.

Owing to the more expensive materials used and the mechanical design of the cell, the nickel cadmium battery cannot compete on a watt-hour basis with lead batteries on first cost. The economic justification for and explanation of the wide use of nickel cadmium batteries over a period of some 40 years is to be found in its long life, freedom from sulfation and corrosion troubles and low cost of maintenance. The chief appeal of nickel cadmium batteries is therefore to officials who have a public service or private operation to maintain at minimum costs, such as providing transportation, furnishing power, pumping oil or making steel.

DISCUSSION

PRESENTED BY

C. BERG, Chief Engineer, Nickel Cadmium Battery Corp., Northampton, Mass.

R. L. BAKER, General Electrical Foreman, Union Railroad, East Pittsburgh, Pa.

PAUL G. PENDORF, District Manager, The Carbone Corp., Pittsburgh, Pa.

Member: Mr. Berg you brought up the fact that the Edison battery was designed for frequent discharges, complete charge and discharge. Suppose, for example, on a diesel locomotive, you find engineers who cannot find a trouble and they keep grinding the battery down so you have to bring it up, and it goes up and down continuously. Will this battery give you that service?

C. Berg: It will. It is not meant for cycle service, but in normal service, including such faults as you normally have on a diesel locomotive or a bus, it will take that satisfactorily.

R. L. Baker: Do you have these batteries in service on diesel locomotives?

C. Berg: Yes, many of them.

R. L. Baker: May I ask the size?

C. Berg: The same size as lead batteries.

R. L. Baker: What is the overall life?

C. Berg: We expect at least 15 years. We do not have complete figures but we expect 15 years.

Paul G. Pendorf: How does the rate of discharge of this battery compare with lead acid at maximum rate?

C. Berg: If we take such a service as a diesel locomotive where you have a certain lead acid battery fitting into a certain compartment, we can give you the same capacity, the same voltage, and the same starting time, that is the engine will start in exactly the same period of time. There is no increased internal resistance. It will give you exactly the same starting service as a lead acid battery.

Member: Is the battery easily damaged with an overcharge?

C. Berg: Extended overcharging even at a normal rate of charge will not damage the battery. What you will do however, is to boil away the water in the electrolyte.

Member: How about trickle charging?

C. Berg: Trickle charging at practically any rate will not damage the cell.

Member: Is it not particularly critical?

C. Berg: It is not particularly critical and you can charge a nickel cadmium battery up to a voltage corresponding to 2.37v per cell without causing it to gas.

Member: How is the capacity at low temperatures?

C. Berg: The capacity of the nickel cadmium battery is for all practical purposes the same down to minus 20 F, but below that it falls away.

Member: How often do you have to change electrolyte in this type of battery, say, in the life of the battery, or 20 years?

C. Berg: If you mean a battery in station service, I have yet to hear of a case where you have to change electrolyte. The worst type of service that I know of is buses, where you have varying traffic conditions and where it is very difficult to hold the voltage regulators to a set point, and in that case, you may have to charge once or twice during the life of the battery. However, when you are speaking of switch opening and switch closing, that is station service, we never change the electrolyte.

Member: You spoke about the specific gravity of your electrolyte. Does your gravity change much from charge to discharge.

C. Berg: Not appreciably.

Member: Then you cannot use a hydrometer to indicate state of charge?

C. Berg: That is right.

Member: That is the same as the old Edison battery?

C. Berg: That is exactly right.

Member: Will your plates buckle under heavy surges, say short circuits?

C. Berg: They will not buckle or grow in service, they will not swell, they will remain just as they are.

Member: What is the age of the oldest nickel cadmium battery still in service?

C. Berg: The oldest nickel cadmium battery that I know of that would be of interest was made in 1913 for diesel engine service. I know of older batteries, but those are on specialized services.

Member: Are they still in service?

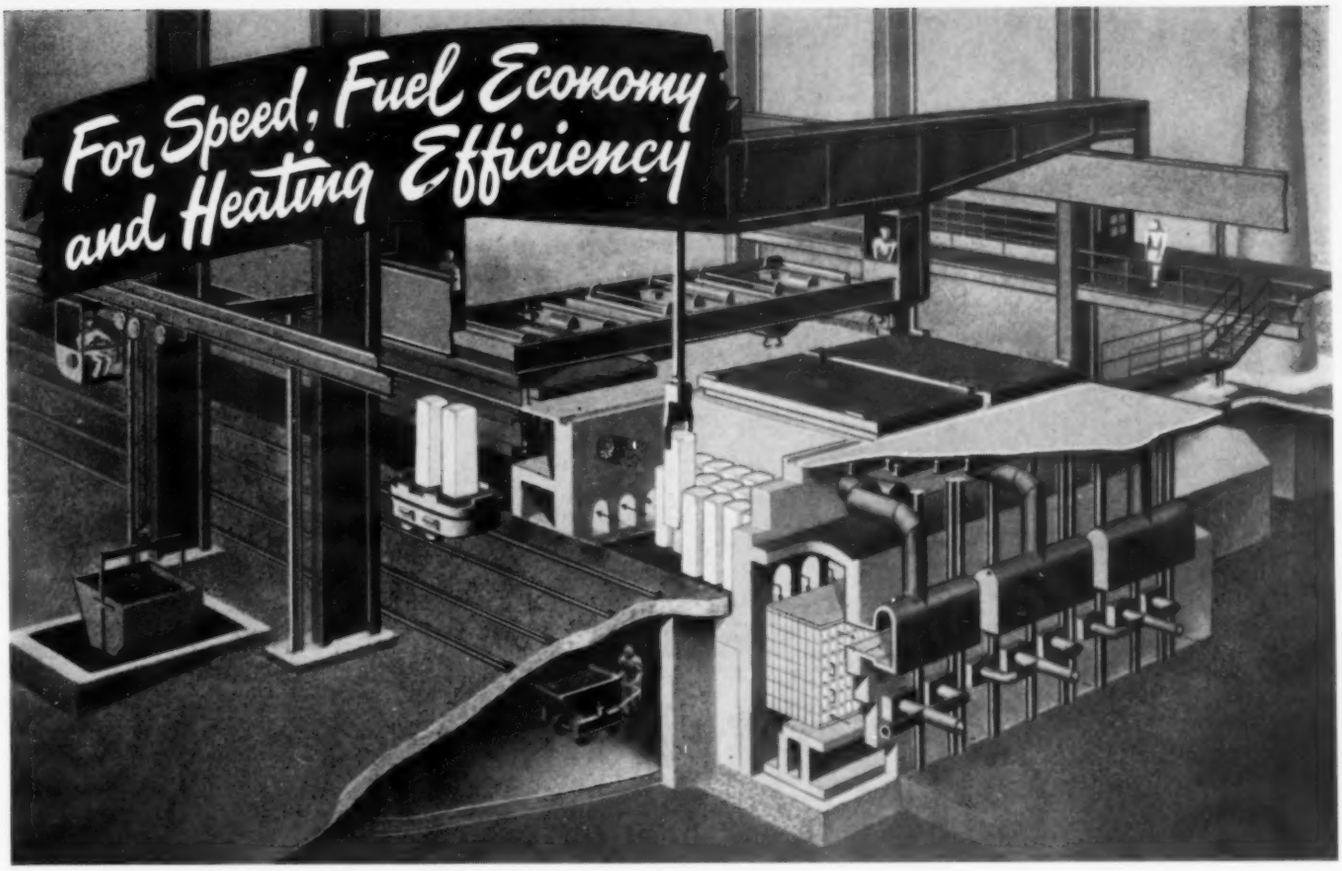
C. Berg: Yes.

Member: What is the difference in your prices compared with the common battery?

C. Berg: The price will vary from the same price as the lead acid battery, with the same service, up to about five times. The average is about two and a half times the price of the lead acid battery.

Member: Do you make these batteries for passenger automobiles?

C. Berg: No, we do not.



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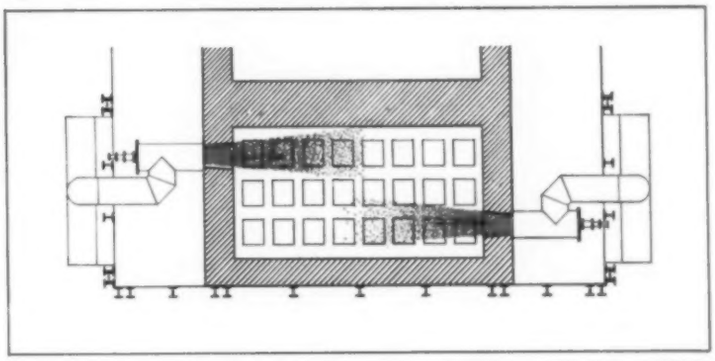

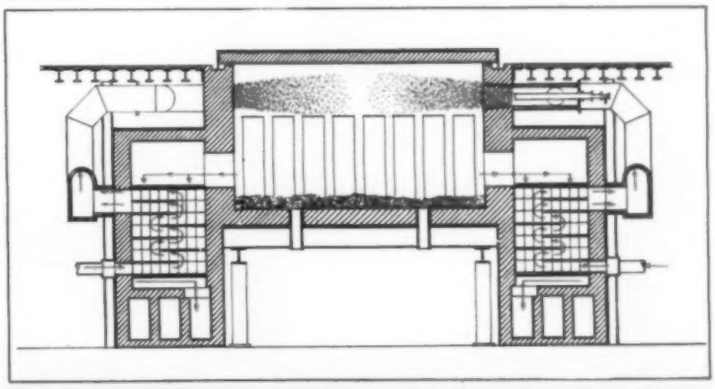

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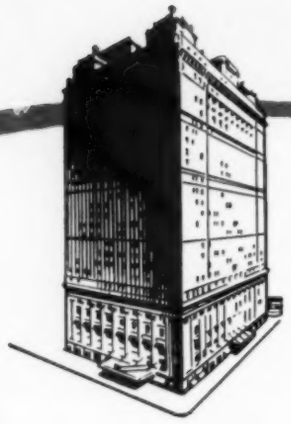

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GRAPHITE STOOL INSERTS FOR BIG-END-DOWN MOLDS

By W. EARLE BLACK
Engineering Department
Jones & Laughlin Steel Corp.
Pittsburgh, Pa.

▲ The steel industry, like all others, is aware of the urgency for reduction of any existing high cost operation. One such item is mold stool costs. Since stool costs are affected by service life, the number of stickers occurring and the expense of preparations to avoid their occurrence, means to reduce the number of stickers have been given close study.

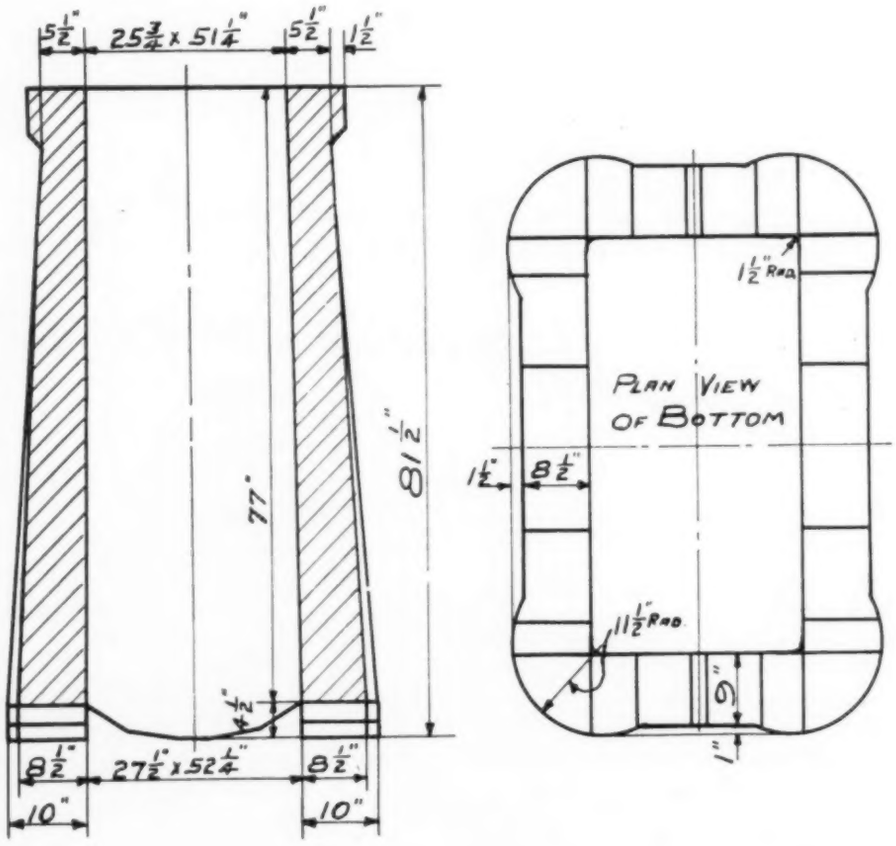
Tests of carbon and graphite inserts in mold stools were begun by Jones & Laughlin Steel Corp. in June, 1944. The primary objectives were to increase stool life and to determine whether ingot stool stickers could be completely eliminated, thereby decreasing track time, heating costs and maintenance costs on cranes. All of these factors contribute toward lowering the net cost per ingot ton of steel and must be considered as contributing to over-all economy in steel production. Our tests and production records show that these objectives have been reached.

MATERIALS

Carbon as a stool insert material has not been very successful. Electric furnace graphite, on the other hand, has properties so adaptable to this service that it is appropriate to direct attention to the difference in these two materials. Carbon has a very low thermal conductivity and is so hard that generally it is cut with metal working tools. Graphite, however, has a thermal conductivity nearly as high as brass, or more than 20 times as high as carbon, and two to three times as high as cast iron; its hardness is less than carbon and it can be easily machined with wood-working tools. In addition, like carbon, it does not deform upon being heated and it is not wet by iron, steel or slag.

Carbon and graphite have a porosity of 22-25 per cent by volume, although the porous cavities are so minute that both appear to be very dense and solid. Because of their porosity, both materials might be ex-

Figure 1 — A graphite insert stool is used with this 27 x 52 in. big-end-down mold.



pected to absorb some moisture when cold. As a precautionary measure, during the casting-in operation the inserts are now preheated overnight in a core-drying oven. Since the possibility of forming steam in the bottom of the molds is a very important consideration from the standpoint of safety and ingot quality, this probability was investigated during the trials. No significant amount of moisture was picked up from the atmosphere or from normal exposure to rain. To further evaluate the moisture pick-up factor as applied to graphite, a series of tests were made. A graphite insert, waterproofed on five faces was submerged under 3 inches of water for a week—thus simulating the effect of a prolonged and heavy rain which might fill the upper face of the stool. The upper face of the insert was not waterproofed so that water was free to enter through that face. After exposure, the insert was subjected to a temperature of 392 F for 2½ hours—stimulating the effect of placing a hot mold on the wet stool. It was found that this heating was sufficient to evaporate all the water absorbed under this extreme condition. It is, therefore, apparent that no difficulty need be anticipated providing the ordinary precautions are used in drying out wet stools.

Although previous experience indicated that the carbon insert had shown little promise, it was nevertheless decided to include this material in these tests. During the series of tests, a total of 17 different grades of carbon and graphite in the form of round and rectangular inserts were compared. It quickly developed that the best insert material would be one that had been fully graphitized. Of all the materials tested, Grade AUZ graphite was found to have the best combination of properties.

DESIGN

Graphite inserts can be cast into stools without difficulty. At the beginning of the testing period there was some doubt as to the ability of the insert to withstand crushing due to shrinkage of metal upon cooling, and accordingly three methods of casting the inserts in were tried: 1. Compressible asbestos mill board was wrapped around the edges of the inserts before they were cast into the stools. 2. Graphite inserts were cast into the stool as a core. The graphite then was chipped out and a 1 in. smaller (width and length) insert was placed in the cored hole and rammed with high temperature cement. The insert did not lift out during the teeming of the ingot but the oxidation rate was high because the cement prevented the heat in the graphite from escaping into the stool. 3. A stool drag was made on a jarring machine. The graphite insert then was placed in the drag in the manner of a core and the stool cast in the flask in the conventional manner. This method was found most expedient in actual production.

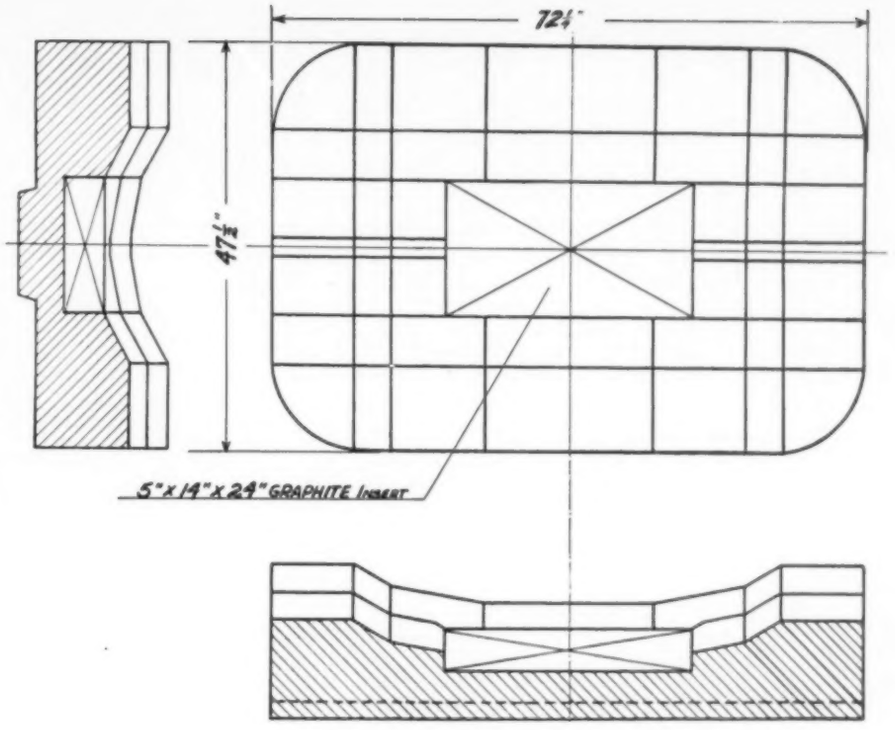


Figure 2 — Dimensions of cross section of cast iron stool for 27 x 52 in. big-end-down mold with 5 x 14 x 24 in. graphite insert.

Opinion as to the proper size of inserts differs considerably. This point can be settled only in relation to the pouring practices of individual mills. Our experience indicates that the inserts should have only the area necessary to take the hot metal impingement, and the mold must rest on the iron of the stool—never on the graphite. A standard rectangular size of 14 x 6 x 24 in. was adopted in our shop in October, 1948, to be formed of special Grade AUZ graphite by National Carbon Co., Inc. Test results with this grade of graphite and insert size show an increased stool life of 86 per cent over the standard all-iron stool.

Stools are cast in our own ingot mold foundry and several grades of blast furnace iron are used. Investigation indicates that bessemer grade iron gives the best overall results.

ECONOMICS

In the production of molds and stools there are many factors controlled by human judgment and workmanship, and these factors may provide better stool life at one mill as compared to another.

Insert wear is governed by the following factors:

Erosion— As a general observation, erosion into the graphite insert is quite slow at the beginning, then becomes increasingly more rapid until the graphite is worn through to the chilled iron, the actual number of pours obtained depending somewhat on the localization of the stream impact. The erosion of the graphite insert is followed by a very slow erosion into the first ½ in. of the chilled iron and finally a rapid erosion for a total of about 2 in. before the stool is discarded. Probably the slow erosion into the first ½ in. of the iron is due to the formation of

iron carbide in the iron surface adjacent to the graphite at the time the stool is cast. When the position of the stream is varied from pour to pour, a stool life of 72 pours has been obtained before replacement was necessary. After the 72 pours, approximately 50 per cent of the graphite was intact although the graphite insert was worn to a 2 in. thickness at the shallowest point.

Oxidation—Oxidation of the insert material has a direct effect on insert life. Oxidation occurs on the hot surface of the inserts after stripping and continues at a very slow rate until the surface temperature is lowered to the range of 850 to 1000 F. A threshold temperature of 850 F is about the critical point at which oxidation of graphite begins when exposed to air. Oxidation of this type can be retarded by flooding the insert with water after the ingot has been removed from the stool. Test results proved this to be true although it is not considered practical in production and is not done at Jones and Laughlin. After the mold is stripped from the ingot, the ingot is loosened from the stool, and it is at this point that the most rapid oxidation occurs, continuing until the ingot is removed from the stool.

In addition to the savings resulting from increased stool life, an even greater benefit has been derived through the elimination of stool stickers. So far as is known, stools with a cast-in graphite insert never have produced a serious stool sticker of the type requiring the use of a stool knocker to loosen the ingot. With all-iron stools, about one pour in 20 will result in a stool sticker. When the stickers occur, the ingot must be loosened with stool knockers; an operation which adds appreciable maintenance expense to the stripper crane mechanism because of the severe impact. Therefore, it is apparent that the use of graphite inserts effect considerable savings incurred in the cost of freeing ingot stickers. These savings are particularly reflected in the soaking pit fuel cost because of the previous delays in getting ingot stickers into the soaking pits.

Figure 3 — A 6 x 14 x 24 in. graphite insert before being cast into mold stool.

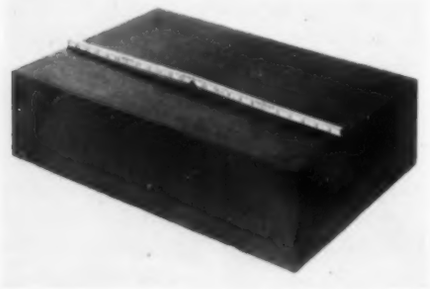


Table 1 shows the average insert life and cost of insert stools per ton of ingots in comparison with the performance obtained with regular cast iron stools at Jones and Laughlin.

The extent and duration of tests conducted by National Carbon Co., Inc. in numerous steel plants allows the following general observations. The number and the location of stool stickers within a train of 20 cars determines the number of ingots delayed in transfer to the soaking pits. Average delay possibilities are:

No stickers in the train	No ingots delayed
All stickers in the train	All ingots delayed
One sticker at the end	One ingot delayed
Stickers at both ends	All ingots delayed
One sticker in the middle	Ten ingots delayed

of all these, and many other possibilities, the one sticker in the middle probably represents an average of all heats. For this average heat of 20 ingots with 10 held up for an average time of ½ hour, the following analysis holds:

No. of ingots delayed (push-pull type stripper crane)	10
No. of soaking pits required for 10 ingots	2
Extra hours of heating per pit	1
Total hours of heating, 2 pits	2
Average ingot tonnage per month	14,500
Average number of heats (20 ingots) per month, 14,500/200	72½
Total number of stickers per month	725
Total hours of extra heating per month	145

Production records show that the elimination of sticker delays, by using graphite inserts, indicates a possible savings of 20 per cent of the present all-iron stool expense per ingot ton of production.

Assuming that there is an average of six full ingots per heat, there is the possibility that in six out of twenty heats one sticker will be present, and will cause delay in getting the six ingots to the soaking pits. The average delay is about 3 hours and, therefore, ingots will require additional time in the soaking pits. On this basis, the following analysis is developed:

No. of ingots delayed (conventional stripper crane)	6
No. of soaking pits required	1
Extra hours of heating required	6
Average ingot tonnage per month	5500
Average number of ingots per month, 5500/10	550
Average number of heats per month, 550/6	91⅔
Average number of heats per month with one sticker, 6 out of 20, or 30 per cent x 91⅔	27½
Total hours of extra heating per month	165

TABLE I

Type stool	Average stool life, per cent	Stool cost per ingot ton, per cent	Savings per ingot ton, per cent	Remarks
Cast iron	Base = 100	Base = 100	...	Average life stools
Graphite inserts	150	Base = 100	...	Break-even point
Graphite inserts	170	89	11	Average insert life, all types iron
Graphite inserts	186	80	20	Average insert life, all bessemer iron

Records show that the elimination of sticker delays saves an equivalent of 65 per cent of the present all-iron stool expense per ingot ton of production.

CONCLUSIONS

The following conclusions have been drawn from experience accumulated during five years of tests and production:

Graphite inserts cast into iron stools give a better service life than those that were insulated or fitted and cemented into a stool cavity.

The tests indicate that rimmed steel is less erosive on graphite inserts than either semi-killed of killed steel.

Tests conducted by the metallurgical department show that the graphite insert has no effect on steel quality.

Stools with cast-in graphite inserts practically eliminate stool stickers.

With a certain grade of graphite and insert size, an increase in stool life of 86 per cent over the standard all-iron stool was realized.

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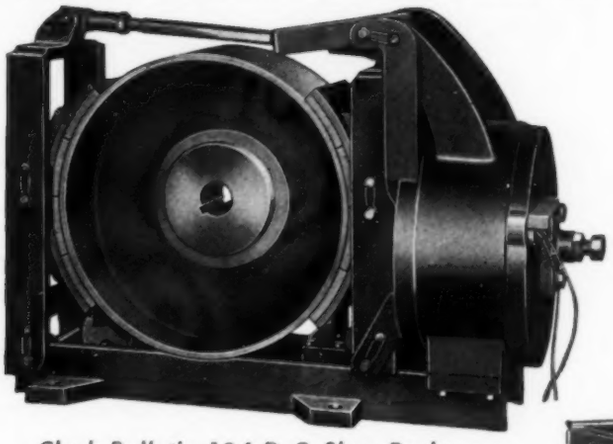

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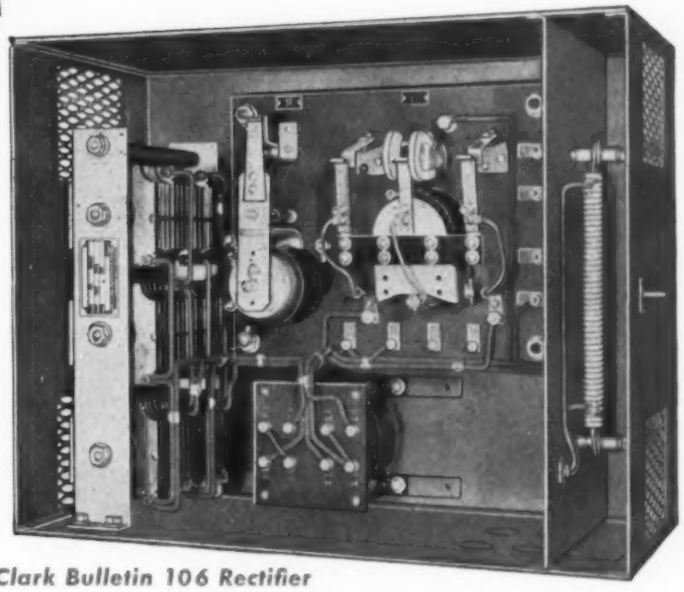

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Britain's Plan for Steel

By ANDREW SCHONFIELD
London, England

▲ Ever since World War II the development of industry in Britain has been dominated by the problems of how to strike a balance between competing demands for supplies of steel. Steel is the basic element in almost every phase of the program for industrial re-equipment. It also enters, in one form or another, into a high proportion of the goods on which Britain's export trade depends. Indeed, engineering products and metal goods of all sorts now make up a larger part of total exports than ever before. The maintenance of these exports is the over-riding need, and that imposes certain limitations on all capital investment—even within the steel industry itself.

The program of development for steel aims at a yearly output of 17,500,000 (long) tons by 1952-3, that is an output one third greater than the amount produced in 1939. But in 1939 the British steel industry reached a peak which it did not regain until last year. Indeed, during the period immediately following the war, in 1945, output was down to less than 12,000,000 long tons. It has been rising steadily since then and by 1948, as some of the first fruits of the development plan began to mature, output reached 14,750,000 long tons. However, these figures by themselves tell only part of the story. Many of the new installations will serve as replacements for existing plants which will be scrapped. By 1953-4 a substantial part of the capacity in the British steel industry will consist of the most modern equipment, producing at low cost.

But the plan is designed to do more than simply modernize and expand Britain's capacity for making ingot steel. Apart from the general shortage of crude steel of all sorts, there is a particular shortage of several types of steel, which a mere increase in the total tonnage produced would not rectify. Demand, both in Britain and in the rest of the world, far outruns, the available supply for two items especially—steel sheet and tinplate.

More tinplate is urgently needed for export to food producing countries like Argentina which rely on supplies from Britain for their canneries. In Western Europe itself, the other Marshall Plan countries are hampered by lack of tinplate. It has been estimated that by 1951 they will still be calling on the United States for supplies of about 250,000 long tons a year. Steel sheet is also required for export; but the immediate and pressing need is for more supplies for export; but the immediate and pressing need is for more supplies to the motor industry at home, which has been operating well below capacity, largely as a result of the shortage.

Both sheet and tinplate are produced by the same initial process, but the main difficulty is to achieve a standard high quality throughout. There have been great technical improvements in manufacturing process in recent years as a result of the introduction of the continuous strip mill, which replaces the older and less efficient hand mill methods. The hand mill is still in widespread use in Britain; and it is the main object of the new steel concern, the Steel Company of Wales, which was founded in 1947 with a capital of 150,000,000 pounds, to modernize this section of the industry. The Steel Company of Wales is the biggest single venture in the post-war development of British industry and is worth describing in some detail.

The main works, which includes a continuous strip mill, is being erected at Margam on the South Wales coast, about ten miles east of Swansea. In order to obtain maximum efficiency and economy in production, the primary processes of steel fabrication, and the mill which rolls the hot steel into sheet, are to be located on the same site. A total of 1,250,000 long tons of ingot steel is to be produced at Margam. New ore preparation plants and blast furnaces are being set up immediately alongside the port. They will receive the high quality foreign ore needed for this type of work, directly as it is unloaded from the ships. The port and docks are being considerably enlarged for the purpose.

At the moment a large part of the site at Margam is still sandy waste. A great deal of work has had to be done to prepare the foundations; they are now for the most part complete. The project is well up to schedule. The strip mill should start operating by 1950, but it will not be in full production until some time later. Before this happens, however, the new capacity for making crude steel will be ready and will temporarily help to provide additional supplies for plants elsewhere.

This is a vast enterprise; and Margam which, when completed, will have the dimensions of a sizable town, is only one part of it. It is an operation on a broad front, for developments in other parts of the South Wales steel industry depends largely on the things which Margam will produce. A cold reduction plant for making tinplate by modern methods, which will use as its basic material hot strip produced at Margam, is being erected at Trostre near Llanelly, South Wales. Materials produced at Margam will also be sent to Newport in Monmouthshire, for the manufacture of special and thin grade sheet.

There is a broader front, still, which includes the whole of Western Europe. Earlier this year the various steel producing countries met together in the Organization for European Economic Cooperation in Paris and agreed to a plan on how the materials and equipment to be made available by the United States for the European steel industry should be allocated among them. Margam was allotted a substantial share. The whole South Wales project can only be brought into operation quickly if the dollars are available to pay for the plant which it has ordered from United States machinery producers. And speed is essential, for one of its functions is to help Europe to save dollars by the time the Marshall Plan comes to an end in 1952.

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Date-line Diary...

August 1

▲ Based on reports from companies having 94 per cent of the steel capacity of the industry, the operating rate of the steel industry is scheduled to be 81.3 per cent of capacity for the week beginning August 1, 1949. This is equivalent to 1,498,800 tons of steel ingots and castings compared with 1,502,500 tons one week ago.

▲ The United Mine Workers' welfare fund director revealed before the Senate Banking Committee that nearly $14,000,000 more was paid out than taken in in the previous fiscal year.

August 2

▲ The collective bargaining agreement between Allegheny Ludlum Steel Corp. and the United Steelworkers of America was extended two months to October 15, 1949.

August 3

▲ Association of American Railroads estimated that, during the first six months of 1949, income of the railroads was $173,000,000 compared with $262,000,000 for the same period the previous year.

▲ The Department of Commerce stated that manufacturers' sales in June were $200,000,000 higher than May, thus reversing the normal seasonal slump. Manufacturers' inventories at the end of the month totaled $30,400,000,000 and were down $500,000,000 during the month.

▲ Colorado Fuel and Iron Corporation cut prices of steel rails $2 a ton to $3.20 a hundred pounds.

August 4

▲ The Department of Commerce reported that unemployment rose to 4,095,000 in July which is the highest since January 1942. Employment, however, remained about the same as the previous month.

▲ The Department of Commerce reported that exports from the United States in June were $26,000,000 higher than May and imports were down $15,000,000 from the previous month.

▲ The Department of Commerce reported that construction work during July climbed to $1,913,000,000 or 10 per cent over the amount done in June. Most of the gain was in private building.

August 5

▲ President Truman stated that Congress will probably not repeal or revise wartime excise taxes for at least a year.

▲ A stockholder suit was filed against the Pittsburgh Steel Co. demanding payments of back dividends owed to the holders of the 5 per cent Class A preferred stock.

▲ Philip Murray stated that there was no agreement between his union and the United States Steel Corp. to the effect that pensions would not be a subject of bargaining this year. This was directly contrary to a statement made by John A. Stephens, vice president in charge of industrial relations of the United States Steel Corp.

August 6

▲ According to the Engineering News-Record, engineering construction contracts awarded during the week ending August 4 set a new high for the year of $239,000,000.

August 7

▲ American Railway Car Institute announced that domestic freight car deliveries during July were 6,434. All orders received during July totaled 488 and the backlog at the end of the month totaled 36,564.

▲ American Iron and Steel Institute announced that the total payroll of the steel industry for the first half of 1949 was estimated at $1,161,000,000, an increase of $107,000,000 over the first half of 1948. This figure is higher than the first six months of any other year. Employment during June was estimated at 624,500, a slight decline from the previous month. Average hourly earnings of wage earners were $1.684 or 1.3 cents less than May.

August 8

▲ The Edison Electric Institute estimated that earnings of electric utility companies for the first six months were a record $391,000,000 or 13 per cent above the like 1948 period.

▲ The Lone Star Steel Company banked two blast furnaces at Daingerfield, Texas, and closed down pig iron production for a period estimated at 60 days.

▲ Based on reports from companies having 94 per cent of the steel capacity of the industry, the operating rate of the steel industry is scheduled to be 82.3 per cent of capacity for the week beginning August 8, 1949. This is equivalent to 1,517,200 tons of steel ingots and castings for the entire industry compared with 1,498,800 tons one week ago.

August 9

▲ One firm raised lead prices 3/8¢ a pound to 15⅛¢ and another firm raised the price to 15¢ a pound.

▲ The White House was drafting a plan to direct government spending in the so-called distress areas where 12 per cent or more of the workers are unemployed.

▲ The Agriculture Department estimates that the cotton crop for 1949 will be 14,805,000 bales or 4/10 of a cent less than 1948.

August 10

▲ The Department of Commerce revealed that business inventories dropped $1,000,000,000 during the month of June and the book value on June 30 is $51,579,000. Practically all reductions were in manufacturers' stock.

▲ Commerce Department reported that personal incomes during June were an annual rate of $213,500,000,000 or about $600,000,000 higher than May.

August 11

▲ The Federal Crop Reporting Board predicted that the corn crop this year will be 3,538,247,000 bushels or the 2nd largest on record.

▲ Interest rates on loans against securities dropped to between 1 and 1¼ per cent from 1¼ to 1⅜ per cent. Call money renewal rate dropped 1 to 1½ per cent from 1¼ to 1¾ per cent.

▲ Herbert E. Gaston, chairman of the Export-Import Bank, outlined plans for insuring private United States investments abroad. Insurance will cover cases when the business cannot convert earnings from foreign investments to dollars, loss of investment through confiscation without compensation and destruction in war.

▲ Contracts were awarded today in which Sollac, a combination of companies in France, ordered $50,000,000 worth of steel mill machinery. Under the contract United Engineering and Foundry Company will furnish a hot strip mill, Mesta Machine Company will furnish a cold strip mill, and the Westinghouse Electric Corp. will furnish the electrical equipment for both these mills. Annual capacity of the hot strip mill will be 700 to 850 thousand tons.

▲ John A. Stephens of the United States Steel Corp. told the fact-finding board that existing labor agreements preclude any bargaining on the union's pension demands until April 1950.

▲ The ICC granted freight rate increases averaging 3.7 per cent over present levels and made permanent a 5.2 per cent rise which was temporarily put into effect earlier in the year. The ICC estimated the total increase in freight revenues since June 1946 would be $3,086,000,000 a year or a rise of 57 per cent.

August 12

▲ The Senate Finance Committee restored the 2¢ a pound duty on copper.

August 13

▲ Henry Kaiser permanently closed down his ship building and ship repair business at Portland, Oregon, because of lack of business.

August 14

▲ The F. W. Dodge Corp. reported that expenditures authorized during July for building and engineering works was $943,560,000 Forty-three per cent was for public-account contracts.

August 15

▲ The United Engineering and Foundry Co. reports net income of $2,565,507 for the six months ending June 30 equal to $3.09 a common share after preferred dividends, compared with $2.32 for the corresponding period one year ago. Net sales were $32,124,567 for the first half of the year compared with $23,894,056 the previous year.

▲ Based on reports from companies having 94 per cent of the steel capacity of the industry, the operating rate of the steel industry is scheduled to be 83.5 per cent of capacity for the week beginning August 15, 1949. This is equivalent to 1,539,300 tons compared with 1,517,200 tons one week ago.

August 16

▲ The Federal Reserve Bank of New York said that figures indicated that drafts uncollected from Latin American countries rose to $185,300,000 or an increase of $7,100,000 during July.

▲ The steel fact-finding board rebuked A. B. Homer, president of Bethlehem Steel Corp., for implying that the board was set up "as a vehicle for forcing upon us important concessions to the unions." Mr. Homer revealed that pay of Bethlehem workers had increased 98 per cent since 1940.

▲ The House of Representatives passed a bill which will prohibit

corporations from buying the assets of other companies when this would substantially lessen competition or create a monopoly.

August 17

▲ The Republic Steel Corp. put into production an open hearth furnace at Massillon and two electric furnaces at Canton. As a result ten out of sixteen open hearths are in operation in the central district, and nine out of twelve electric furnaces.

▲ E. L. Ryerson, chairman of Inland Steel Co., told the steel fact-finding board that negotiations between his company and the CIO United Steelworkers were broken off because of government influence.

▲ The Department of Commerce estimated that output of goods and services declined 2.4 per cent to a yearly rate of $256,100,000,000 in the second quarter of this year or $6,400,000,000 below the first quarter's rate.

▲ Secretary of Labor Maurice Tobin told President Truman that industrial jobs would increase by 1,000,000 by the end of 1949.

▲ National Steel Corp. declared a dividend of $1.25 a share for the third quarter in 1949.

▲ The Continental Foundry & Machine Co. received an order to build a blooming mill for a steel plant in Yugoslavia.

▲ Secretary of Agriculture Brannan announced that the Commodity Credit Corp. will expand grain storage 500,000,000 bushels or about ten times that existing.

August 19

▲ Operations of electric furnaces during the month of July were at 33.8 per cent of installed capacity.

▲ Texas Railroad Commission increased the quota for Texas crude oil production for the month of September. This is the first time that this has been increased since last December.

▲ Admiral Ben Moreell stated that net income of the Jones & Laughlin Steel Corp. for the second half of 1949 will be about $5,000,000 compared with $19,730,550 for the same period the previous year. Estimate was based on 74 per cent of capacity operations.

August 20

▲ The Bureau of Employment Security announced that new unemployment dropped to a new low for 1949. Initial claims for jobless compensation were 291,000 or 71,000 below the previous week.

▲ Mr. C. M. White, president of Republic Steel Corp., told the fact-finding board that the union's demands would cost his company more each year than it ever earned except in 1948.

August 21

▲ The Lake Superior Iron Ore Association reported that consumption of iron ore in July was 5,258,321 gross tons compared with 6,248,535 in June. Blast furnaces operating on August 1 totaled 142 or seven fewer than on July 1.

▲ The Barium Steel Corp. purchased the Phoenix Iron Works Corp. and the Phoenix Bridge Corp. for more than $2,000,000 from the Kaiser-Frazer Corp. Production will resume about September 19.

August 22

▲ William T. Faricy, president of the AAR, told the ICC that the railroads are going to try to meet the cost of the 40-hour week without asking for further rate boosts.

▲ According to a survey, profits of industry during the second quarter dropped 12.6 per cent from the previous year. This is the first time since the end of the war that industry failed to show a rise in earnings for such a period.

▲ National Machine Tool Builders' Association reported that machine tool orders and shipments declined to new postwar lows in July.

▲ Lead shipments and copper deliveries for the month of August will be up appreciably over quantities for July.

▲ Based on reports from companies having 94 per cent of the steel capacity of the industry, the operating rate of the steel industry is scheduled to be 84.8 per cent of capacity for the week beginning August 22, 1949. This is equivalent to 1,563,300 tons of steel ingots and castings for the entire industry compared to 1,539,300 one week ago.

▲ At the steel fact-finding board hearings, R. Conrad Cooper, vice president of United States Steel Corp., stated that manhour productivity has not risen 50 per cent between 1939 and 1949 as estimated by Robert R. Nathan.

▲ The Department of Commerce announced that Russia has resumed manganese ore shipment to the United States after a two months lapse and $100,000 worth was imported in June.

▲ Contracts have been awarded for construction of a new pressed steel plant in Buffalo for the production of parts for Ford cars.

▲ The Surface Combustion Corp. has been awarded a contract to build twenty coil annealing furnaces and sixty bases for the Lackawanna Works of the Bethlehem Steel Co.

▲ Hiland G. Batcheller, president of Allegheny Ludlum Steel Corp., stated that under present conditions his company's break-even point is about 60 per cent of capacity.

▲ Enders M. Voorhees, chairman of the finance committee of the United States Steel Corp., stated before the steel fact-finding board that the goals of the steel workers have arisen from the "bitter race for power of giant labor monopolies."

▲ Great Britain's foreign trade deficit dropped to $162,000,000 in July from $216,800,000 in June. Exports were $566,800,000, or the lowest since last October.

▲ A survey of the Labor Department in July showed no new major sections in the country where unemployment was over 12 per cent.

August 24

▲ The American Institute of Steel Construction reported July bookings of structural steel were 124,256 tons which is the second largest this year. July shipments were 141,120 tons.

August 25

▲ With the exception of the automobile industry, heavy manufacturing industries dropped employees in July according to the Labor Department. Of 110,000 employees laid off, the iron and steel group laid off the most, 40,000 men. The automobile industry added 20,000 men.

▲ The United Steelworkers (CIO) told the steel fact-finding board that they would be willing to modify pension and insurance clauses in contracts with steel companies if federal social security benefits were increased.

▲ Mr. John E. Kelly, mining consultant to the New England Council, stated that at least one company is interested in building a $200,000,000 steel plant in New England. Iron ore for this plant would probably come from Labrador, and Mr. Kelly estimates that it would cost from $0.75 to $1.00 less to use Labrador ore than Mesabi ore on the lakes.

▲ According to the American Iron and Steel Institute, blast furnace production in July was 4,173,311 tons of pig iron, ferromanganese and spiegeleisen or 69.8 per cent of capacity which is the lowest since April 1948.

▲ Robert R. Nathan told the steel fact-finding board that the steel company witnesses showed a defeatist attitude on the business economy.

August 26

▲ The Department of Commerce reported that the iron and steel industry paid out in dividends $32,000,000 more in the second quarter of 1949 than in the second quarter of 1948.

▲ The Carnegie-Illinois Steel Corp. started up another blast furnace at Youngstown, thus putting five into operation. Seventeen out of 25 furnaces are now in operation in that district.

▲ The Department of Commerce eased tin controls and removed bans on private imports of pig tin as well as all controls on how tin is to be used in this country except for tin in cans and bottle caps. The last two restrictions go off on December 1.

▲ A. J. McIntosh, economist for Socony-Vacuum Oil Company, Inc., predicted that crude oil used east of California will have to rise 650,000-750,000 barrels a day above the July level of 3,850,000 barrels a day to meet demand.

August 27

▲ The ECA approved two projects for reconstruction and modernization of two Italian steel plants wrecked during the war. Plants involved are a subsidiary of Finsider at Bagnoli and Piombino, Italy. The cost is estimated at $57,000,000.

August 28

▲ Secretary of Commerce Sawyer told the White House that the nation's economy seemed to be in good shape.

August 29

▲ Commerce Department reported that cash dividend payments in July were $493,600,000 compared with $496,100,000 one year ago. Payments for the second quarter were $1,512,700,000 or an increase of 8 per cent over the 1948 period.

▲ Robert P. Patterson speaking for 16 of the smaller steel companies said that the smaller concerns in the industry cannot raise wages and still make a fair profit.

▲ Based on reports from companies having 94 per cent of the steel capacity of the industry, the operating rate of the steel industry is scheduled to be 86.3 per cent of capacity for the week beginning August 29, 1949. This is equivalent to 1,591,000 tons of steel ingots and castings for the entire industry, compared to 1,563,300 tons one week ago.

▲ The Aetna-Standard Engineering Co. is to build a complete continuous butt weld tube mill for the Youngstown Sheet and Tube Co.'s Indiana Harbor Works.

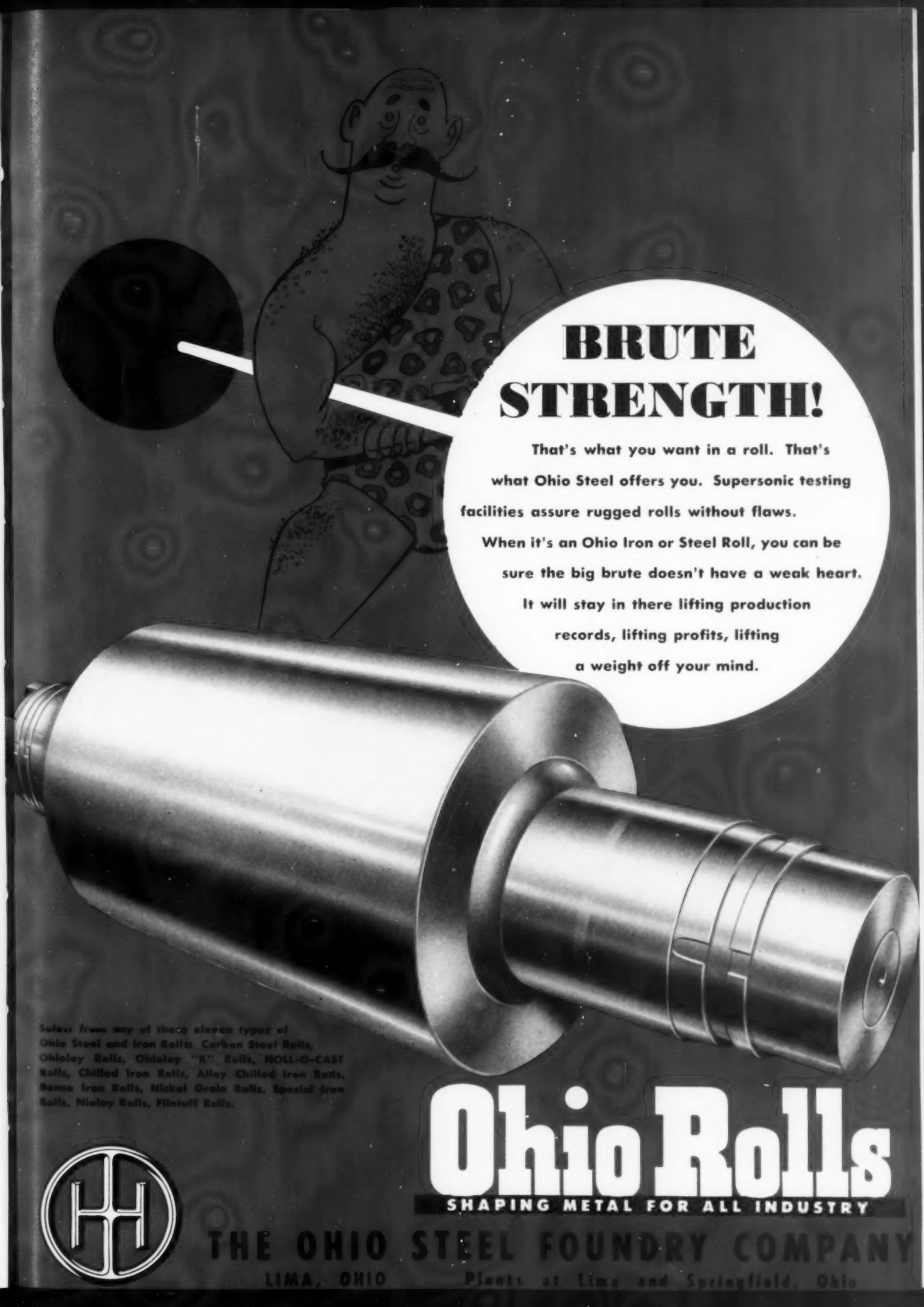
▲ Manufacturers' sales in July dropped $1,500,000,000 from June to a figure of $15,000,000,000 according to the Department of Commerce. The dip was most pronounced in the iron and steel and electrical equipment industries.

▲ The Federal Reserve Board reports that industrial output increased in August for the first up-turn since last August.

▲ The presidential steel fact-finding board withdrew its offer to mediate in the dispute between steel industry and the steelworkers. This was done after the industry stated that talks must be handled on an individual company basis.

August 31

▲ The Senate voted a boost in the minimum pay from 40¢ to 75¢ an hour for the companies engaged in interstate commerce.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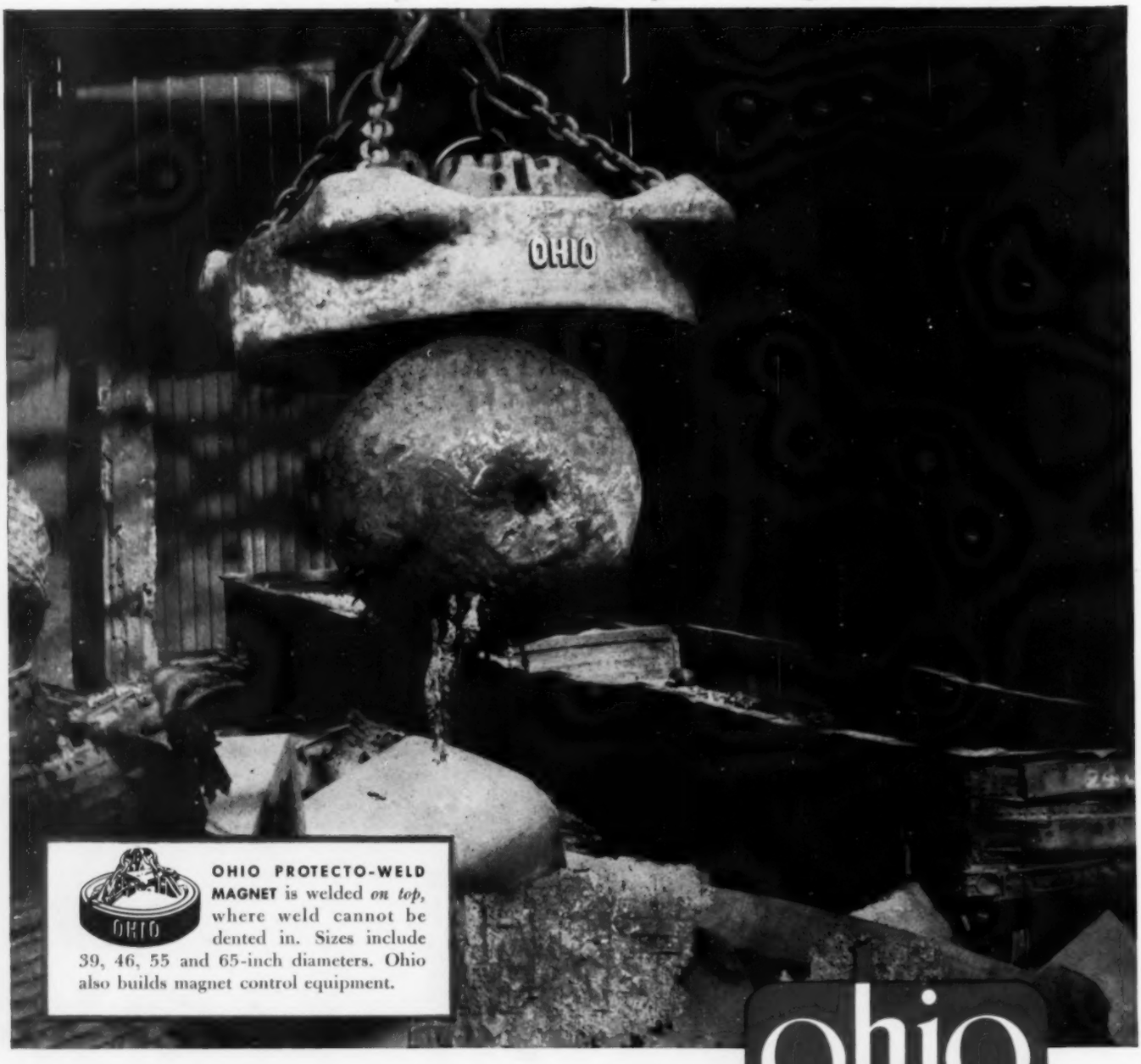

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Industry News...

KAISER STEEL JOINS WITH BASALT ROCK TO INCREASE WEST COAST PIPE PRODUCTION

▲ A manufacturing and sales agreement which will increase West Coast production of large diameter steel pipe for the growing pipe line industry was announced jointly by Kaiser Steel Corp. and the Basalt Rock Co.

It was disclosed that the Basalt plant located at Napa, Calif., on the San Francisco Bay, which presently produces standard sizes of electric resistance weld steel pipe ranging from 8-5/8 in. to 20 in., is adding facilities at Napa to enable it to produce expanded electric fusion weld steel pipe up to 36 in., which will meet the high yields required by the oil and gas industries.

Plate for the pipe will be supplied from the Kaiser steel mill at Fontana, Calif.

The Kaiser sales organization will market the steel pipe produced at Napa under the label "Basalt-Kaiser."

The Kaiser-Streblow statement explained that post-war growth of the Midwest and West Coast Regions has produced an ever-increasing demand for natural gas and oil which means that the pipe line industry will require huge amounts of steel pipe in the next few years.

Under this program the production of pipe at Napa from 8⅝ in. to 20 in. in size will be increased through the installation of a Yoder electric resistance welding unit in early September. The new facilities for producing the larger pipe ranging from 22 in. to 36 in. in size will be in operation beginning in early 1950.

All sizes of steel pipe from these facilities will be produced in 40 ft lengths and will meet ASTM and API standard specifications.

Basalt's success in steel pipe manufacturing has given the company a reputation for high-quality production that has resulted in orders from customers throughout the world. Engineers who have inspected the equipment developed at the Napa plant assert that it is among the most efficient in the industry.

This pipe agreement is strengthened by the fact that there is only one other manufacturer of large diameter steel pipe west of Milwaukee.

Meanwhile, Kaiser Steel is now building a new electric weld mill at Fontana, California, to produce pipe in sizes ranging from 5 9/16 in. to 14 in. This mill is expected to be in operation by the first of next year. Kaiser is already producing at Fontana continuous weld pipe in sizes ½ in. to 4 in.

Upon completion of these separate expansion programs, Kaiser Steel, in combination with Basalt, will be able to offer a complete range of steel pipe sizes from ½ in. to 36 in.

FRENCH COMBINE BUYS ROLLING MILLS IN U. S.

▲ Sollac (Societe Lorraine de Laminage Continu), a privately owned association of nine French steel firms, has just placed an order for $9,500,000 worth of electrical steel mill equipment with the Westinghouse Electric International Co., New York, N. Y.

The order—largest single order of its type ever placed—comprises electrical equipment for two new steel mills at Hayange and Ebange, neighboring towns in the iron ore-producing Moselle sector of northeast France. When completed, these mills will process a minimum of 850,000 tons of raw steel annually into light plate sheet steel and tin plate, Mr. Knox said.

One of the founders of Sollac, which represents half the productive capacity of the French steel industry, was the late Francois de Wendel, whose family has been in the iron business since 1705, and who, when Sollac was founded, headed the largest single steel interest in France.

The new steel mills will supply the flat rolled steel essential for the operation and expansion of consumer product industries. The use of flat rolled products in France has risen more than 50 per cent in the past twenty years, while at the same time consumption has fallen off on all other types of steel.

For the first phase of the modern-

Raymond Colmant, director of Sollac, is shown signing the contract for a 6-stand continuous hot reduction mill together with roughing stands, tables, shearing line, and auxiliary equipment. K. C. Gardner (left), president of United Engineering and Foundry Co., promised delivery within 20 months. J. M. Misset, assistant to the president of Sollac, is on the right.

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SHEAR BLADES
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Any type or size blade of proper Alloy with correct hardness and temper for every type shearing machine and every kind of job.
Rx ENGINEERED TO THE JOB
Every Wapakoneta blade is made to exact specifications, designed for the particular job. Complete records with order number of each blade makes possible duplication of exact size and temper at any time.
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ization program, Westinghouse will supply electrical equipment including motors, generators, switchgear, and controls for an 80-in. continuous hot-strip mill at Hayange and for a 48-in. five-stand continuous cold-strip mill at Ebange. The hot-strip mill, which will be powered by a 13,500-volt power source, will have main motor drives with a total of 46,000 hp. Capacity is estimated at 700,000 tons a year. The cold-strip mill will have main motor drives with a total of 15,000 hp as well as a 500 hp reel motor. Capacity of the mill is estimated at 300,000 to 400,000 tons a year.

The mill equipment will be furnished by the United Engineering and Foundry Co., Mesta Machine Co., and the Wean Engineering Co.

ATLAS RESEARCH LAB DEDICATED TO FOUNDER

The Atlas Research Laboratories were dedicated at Mertztown, Pa., August 20 as a memorial to the late Maximilliam F. Wirtz, who founded the firm in 1892. The new laboratories are housed in a two story brick building with over 5,000 sq ft of floor space. The unit laboratories are 15 ft x 15 ft with one chemist and an assistant assigned to each. A modern library with over 2,000 technical volumes and research administration office occupy part of the second floor. Atlas materials of chemical construction are used on the outside of the building, walkways, laboratory benches, floors, hoods, and interior trim.

The Atlas laboratories are staffed by twelve chemists and technicians under the direction of Dr. Raymond B. Seymour, technical director, and Joseph Dahle, research director. The control laboratories now occupy a building in the plant area formerly used for both research and control. The research laboratories are far enough removed from the plant area to permit a certain amount of freedom from day to day plant problems which are handled by the control group.

The Atlas laboratories are adequately equipped for the investigation of the problems related to corrosion-resistant materials. During the open house, staff members explained the operation of physical testing apparatus, laboratory rub-

ber mill, plastic molding press, electrometric titrimeter, Brookfield viscometer, spectrophotometer, laboratory homogenizer, SR-4 strain gages and other specialized apparatus. It was also announced that a research project on the fundamental investigation of sulphur compound pipe joints was underway in cooperation with staff members of Lehigh University.

KAISER CHANGES NAME TO KAISER STEEL CORP.

▲ Kaiser Co., Inc., on August 2 changed its name to Kaiser Steel Corp.

The old title was adopted by the company in December, 1941, when Henry J. Kaiser was asked by the U. S. Maritime Commission to build Yard 3 at Richmond, Calif., and the Swan Island yard at Portland, Ore.

Early in 1942 ground was broken for the Kaiser Steel plant at Fontana, Calif. Since then the shipyards have been dismantled, but the steel plant has grown steadily to the point where it has capacity of one million tons of ingots annually.

As Kaiser Steel Corp. operates six modern and efficient rolling mills, with two more to be added by the end of the year, manufacturing a wide range of products including plates, strip, sheets, structurals, pipe, skelp and bars.

FAFNIR ANNOUNCES PILLOW BLOCK LINE

▲ To round out its extensive line of anti-friction bearing industrial units, Fafnir Bearing Co. announces the development of a series of normal and heavy-duty spherical roller bearing pillow blocks. Spherical roller bearings for these units will be manufactured by Torrington Co., long a leading producer in this specialized field, as is Fafnir in the ball bearing field.

The broadening of its line enables Fafnir to offer anti-friction bearing pillow blocks for practically every requirement of speed, load and operating condition encountered in modern industrial usage, particularly in mining, construction, lumbering, petroleum, and other heavy duty fields. The new spherical roller bearing line is designed especially to handle heavy loads over long periods of service with economies in power and maintenance. It will supplement the wide range of pillow blocks and other ball bearing power transmission units manufactured by Fafnir for more than a quarter-century.

Spherical roller bearing pillow blocks will be available in bore sizes ranging from $2\frac{7}{16}$ in. to approximately 8 in. They will be self-aligning, incorporating either felt or triple metallic labyrinth seals, and units will be built for either straight shaft or adapter type mounting. First shipments are scheduled for about Jan. 1, 1950.

REFRACTORY FIRM OPENS CLEVELAND BRANCH

▲ Ramtite Co. has established a direct branch office with complete warehouse stocks of refractory materials. The office will be located at 1530 River Bed Avenue, Cleveland 13, Ohio.

WATER CONDITIONING FIRM IS ESTABLISHED

▲ Graver Tank & Mfg. Co., Inc., has announced the establishment of the Graver Water Conditioning Co. as a division of the company to extend the operations which have been conducted by the Graver Water conditioning and process equipment department.

Graver has been actively engaged in the water conditioning field for 40 years, and the expansion of the staff and facilities which accompanies this development enables the company to provide individualized and complete technical, chemical, engineering, manufacturing and erection services for all water treatment and liquid conditioning requirements.

The products of Graver Water Conditioning Co. include hot process softeners, deaerating heaters, zeolite softeners, cation and anion exchangers, demineralizers, clarification and filtration equipment, reactivators, and chemical feeders.

ZINC PLATING FIRM ORGANIZED IN CHICAGO

▲ Azed, Inc. (pronounced á-zed), a new corporation jointly owned by Poor & Co., Chicago, and the Acme Steel Co., Riverdale, Illinois, has recently been formed to engage in the research, manufacture and sale of

(Please turn to page 156)

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These 106 new Koppers-Becker Underjet Coke Ovens carbonize approximately 2,600 net tons of coal per day. Built in two batteries, they are equipped with Waste-Gas Recirculation and Blast-Furnace Gas Underfiring Equipment.

Koppers enlarges the scope of its

Koppers Company, Inc., has purchased the Freyn Engineering Company and its subsidiary, the Open Hearth Combustion Company. In becoming a part of the Koppers organization, Freyn will be operated as a wholly-owned subsidiary; it will continue under its present name, at the same address: 109 North Wabash Ave., Chicago 2, Ill.

This plant was constructed by Koppers for recovery of ammonium sulphate, tar, light oil and pure benzol products from the carbonizing of 1,050 tons of coal daily.

Koppers constructed this light oil refining plant in South America to produce pure benzol, toluol, xylol, and solvent naphtha. Capacity is 5,000 gal. of light oil per day.

Freyn Engineering Company, subsidiary of Koppers Company, Inc., designed and constructed this open hearth furnace for the National Steel Company of Brazil.

services to the steel industry

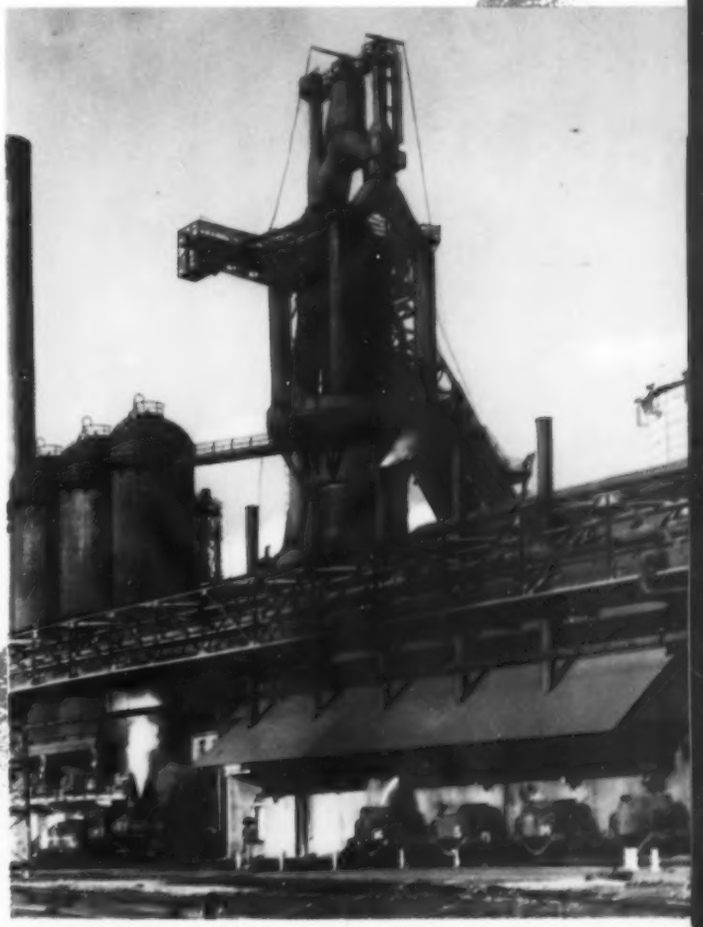
FREYN Engineering Company has specialized in the design and construction of blast furnaces, open hearth furnaces and sintering plants . . . in the engineering of mills and other steel plant facilities.

Koppers Engineering and Construction Division has long been recognized as a leader in the design and construction of coke oven plants, auxiliaries and coal chemical plants.

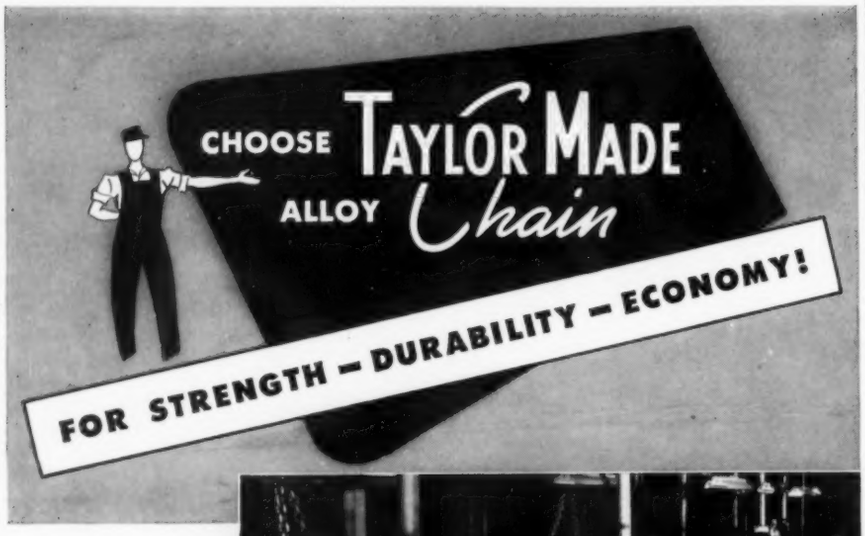
With this combination of forces, Koppers is in a position to render comprehensive and coordinated design, engineering and construction services to all branches of the iron and steel industry, both here and abroad.

KOPPERS COMPANY, INC.
ENGINEERING AND CONSTRUCTION DIVISION
Pittsburgh 19, Pa.

KOPPERS



Typical blast furnaces built by the Freyn Engineering Company.



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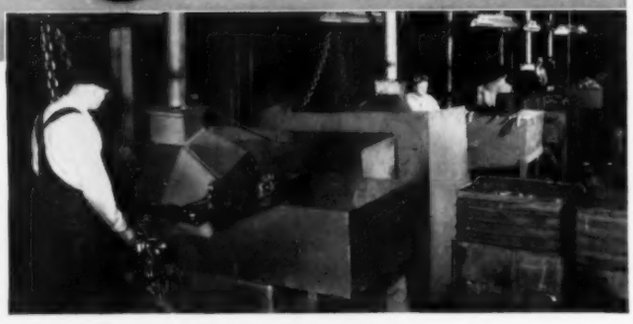
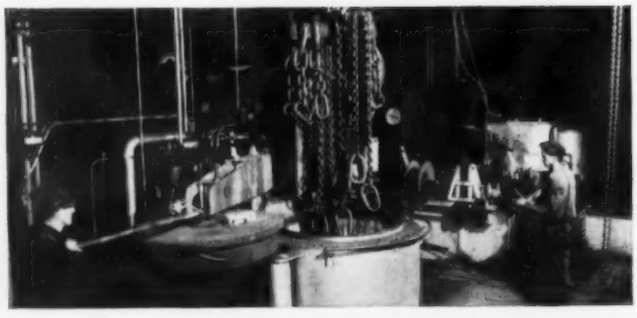
TWO U-shaped half links are electrically welded to form stress-free links, by only the most experienced craftsmen.





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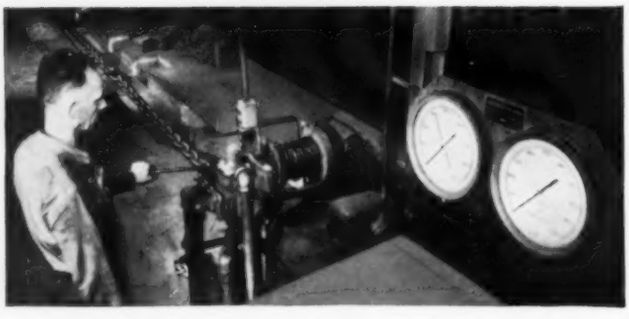
TM Alloy Steel Chain is subjected to gruelling tests before shipment. It has twice the working load limit of wrought iron or low-carbon steel chain of the same size.



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National Safety Congress

(Continued from page 153)

products and processes for all phases of the application and secondary treatment of zinc surfaces. The company will serve zinc electroplaters, hot dip galvanizers and zinc base die cast manufacturers and finishers.

President of the new corporation is F. A. Poor, chairman of the board of Poor & Company. Azed vice presidents are C. S. Traer, chairman of the board of Acme Steel; C. J. Sharp, president of Acme Steel and A. E. Chester, research director of Poor & Company. Vice president and treasurer is P. W. Moore, president of Poor Company. P. W. Moore, Jr. is secretary, and R. R. Jenkins, general manager. Azed offices are located at 80 E. Jackson Blvd., Chicago 4. Laboratories are maintained at Riverdale and Waukegan, Illinois. The factory is at Waukegan.

Company officials state that the formation of Azed, Inc. is the outgrowth of over six years of research and development work during which time numerous new chemical products and processes have been field tested and are ready for the market. It is claimed that the organization is engaged in the most elaborate and comprehensive research program ever carried on in connection with zinc plating and finishing.

STRESS ANALYSIS GROUP TO MEET IN NEW YORK

▲ The annual meeting of the Society for Experimental Stress Analysis will be held at Hotel New Yorker, New York, N. Y., November 30, December 1 and 2, 1949. Inquiries should be addressed to the Society for Experimental Stress Analysis, P. O. Box 168, Cambridge 39, Massachusetts.

LACKAWANNA PLANT BUYS COIL ANNEALING FURNACES

▲ A contract for what is believed to be the largest single commitment for coil annealing furnaces was recently placed by the Bethlehem Steel Co. for their Lackawanna, N. Y. Works.

Twenty furnaces and sixty bases are to be built by Surface Combustion Corp. under the terms of this contract. The furnaces will be of the horizontal radiant tube type and will

be arranged with the sixty bases in a double row, each base accommodating eight stands of coils.

The annealing covers will accommodate coils 67 in. in outside diameter which may be piled to a maximum height of 148 in. Total charge of coiled steel per base is approximately 450 tons. This means that as much as 27,000 tons of steel may be in process at any one time.

1949 STEEL PAYROLL HIGHEST IN HISTORY

▲ The total payroll of the steel industry in the first half of 1949 is estimated at $1,161,000,000, an increase of $107,000,000 over the first half of 1948, American Iron and Steel Institute announced recently.

That total, which excludes payrolls in nonsteelmaking operations, was higher than in the first half of any other year. It exceeded the payroll for the entire year 1940 or any preceding year, and was almost as high as the total for the full year 1941.

Employment in the iron and steel industry in June was estimated at 624,500, a decline of two per cent from May and of 1.4 per cent from June 1948. June employment remained higher, however, than the monthly average for any postwar year except 1948.

Average hourly earnings of wage earners in June were $1.684, 1.3 cents less than in May, but 11.5 cents higher than in June 1948. Wage earners' average hours of employment in June increased to 37.6 hours a week from 37 hours a week in May.

These data are based on reports from 118 companies representing approximately 94 per cent of the capacity of the industry. They cover employees engaged only in the production and marketing of iron and steel, excluding mining, shipbuilding and other nonsteelmaking activities.

SHEET AND TUBE BUILDS MORE PIPE MILLS

▲ Aetna-Standard Engineering Co., steel plant equipment maker, is building a complete continuous butt weld pipe mill at its Ellwood City, Pa. and Warren, Ohio, shops for Youngstown Sheet & Tube Co.

The new mill will be installed at Youngstown Sheet & Tube's Indiana Harbor, Ind., works and will enable Sheet & Tube to compete more aggressively for pipe business in the Chicago area.

Aetna-Standard's order calls for the mill complete with finishing floor equipment and two pipe galvanizing units.

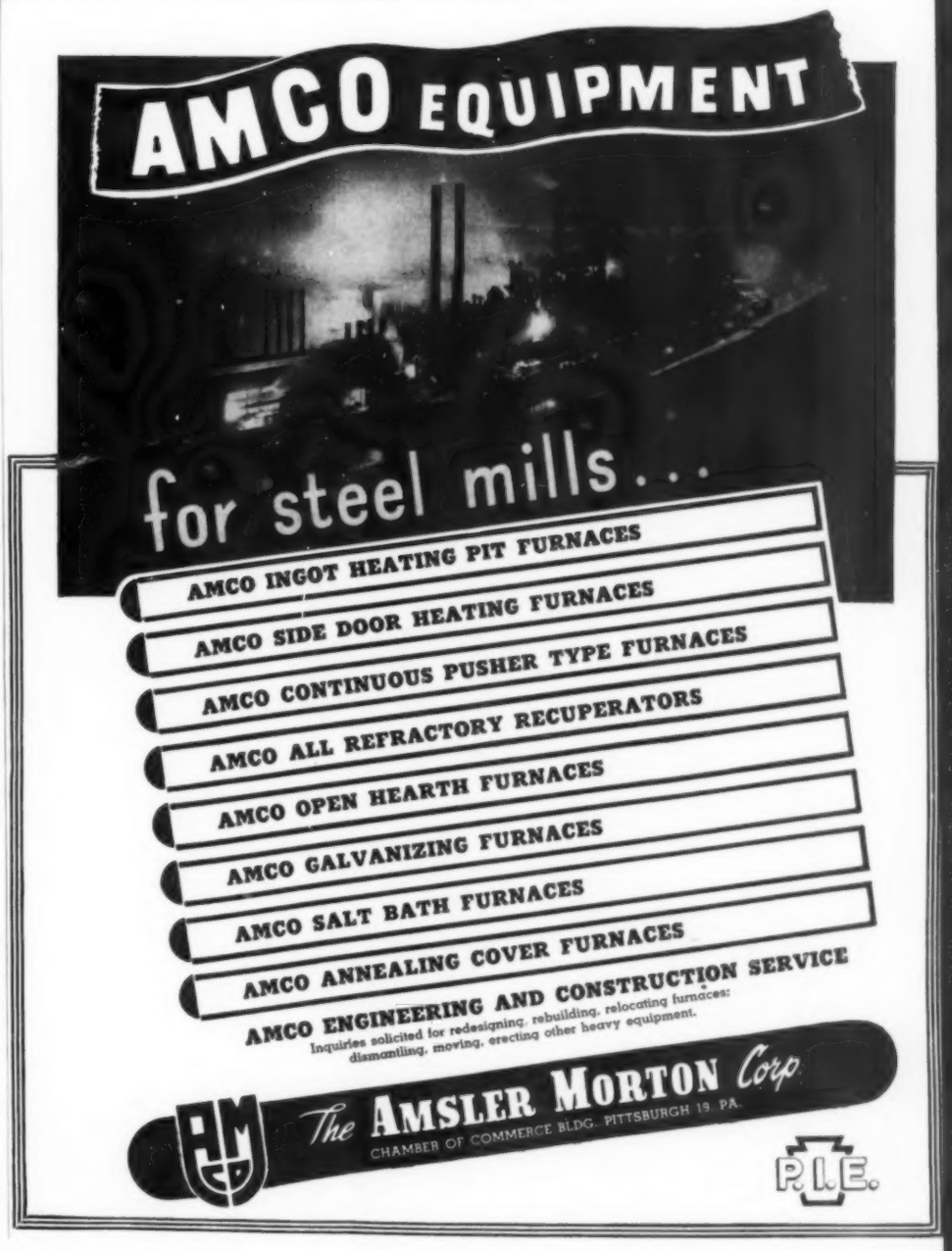
Aetna-Standard also recently built a continuous butt well pipe mill for Wheeling Steel Corp. at Benwood, W. Va., and completed two continuous seamless mills for National Tube Co., one at Gary, Ind., and the other at Lorain, Ohio. It also installed two continuous strip galvanizing lines for Tennessee Coal, Iron & Railroad Co. at Fairfield, Ala.

FIRM TO ENGINEER INDUSTRIAL INSULATION

▲ Formation of Mechanical Industries, Inc., a new engineering company whose activities will be limited to industrial ventilation, smoke, dust and fume control with headquarters in Pittsburgh, Pa., has been announced by Morton I. Dorfan, president and general manager.

Nationally known as an expert on industrial dust and fume engineering, Mr. Dorfan has been associated in this field more than 35 years. Prior to establishing the firm which he will head, Mr. Dorfan supervised dust control sales, engineering and research activities for the American Wheelabrator & Equipment Corp.

Previously he had served in similar capacities with Allis-Chalmers Co., Pangborn Corp., Blaw-Knox Co., and as a private consultant to industry.


AMCO EQUIPMENT
for steel mills...
AMCO INGOT HEATING PIT FURNACES
AMCO SIDE DOOR HEATING FURNACES
AMCO CONTINUOUS PUSHER TYPE FURNACES
AMCO ALL REFRACTORY RECUPERATORS
AMCO OPEN HEARTH FURNACES
AMCO GALVANIZING FURNACES
AMCO SALT BATH FURNACES
AMCO ANNEALING COVER FURNACES
AMCO ENGINEERING AND CONSTRUCTION SERVICE
Inquiries solicited for redesigning, rebuilding, relocating furnaces; dismantling, moving, erecting other heavy equipment.
The AMSLER MORTON Corp.
CHAMBER OF COMMERCE BLDG. PITTSBURGH 19, PA.
AMCP
P.I.E.

MACK-HEMP ROLLS

with the STRIPED RED WABBLERS

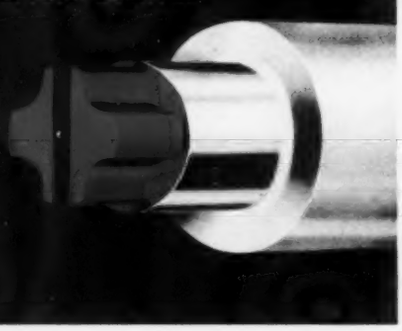
Here's a simple, quick-reference chart for identifying your hard-working Mack-Hemp Rolls with the Striped Red Wabblers.

When there's a productioneering job to be done, in ferrous or non-ferrous rolling, be sure to specify Mack-Hemp Rolls. Simply define the rolling operation you want to do and we'll recommend a Striped Red Wabbler Roll with the strength and service-capacity for that job.

For ready reference, just post this identification chart in a convenient place. We'll be glad to send you extra copies for your bulletin boards.

RED WABBLER WITH BLACK STRIPE

"Technichill" Iron Utility Rolls—used in hot rolling of sheet and tin plate stock, as well as in small bar and merchant mills. Available with or without molybdenum content.

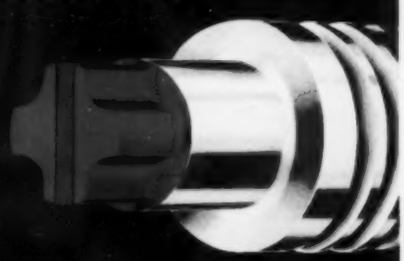


RED WABBLER WITH ORANGE STRIPE

"Nichillite" Rolls of Cast Nickel Alloy Iron—close-grain chill-type rolls adaptable to high polish. Made especially for Mills such as 4-high cold mills in which special finishes are required.

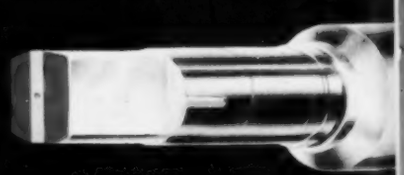
RED WABBLER WITH GREEN STRIPE

Multi-Purpose "Technigrain" Rolls of deep hardness and controlled alloy content—used in small rod and bar mills, as well as on intermediate and finished stands of merchant and small-shape mills.



RED WABBLER WITH YELLOW STRIPE

"Nironite" Rolls of Special Nickel Alloy Grain-Type Chilled Iron—hard surfaced rolls with tough inner core and neck structure, developed especially for hot strip mills but equally effective on plate and cold mills.

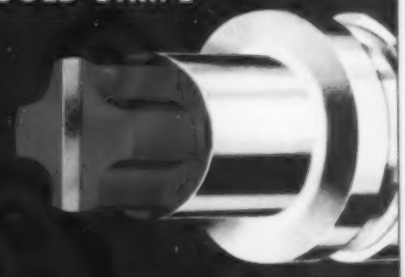


EASY TO IDENTIFY

EASY TO CLASSIFY...

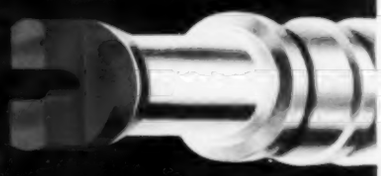
RED WABBLER WITH GOLD STRIPE

M-H "Supermetal" High Carbon Alloy Rolls, Fine Grain Structure—strong, tough rolls suitable for intermediate and finishing passes on structural mills, for plate mills rolling floor-plate, and in billet and bar mills where controlled hardness of rolls is essential to good finish.



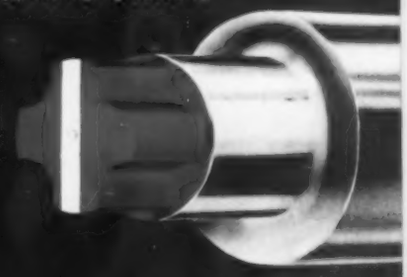
RED WABBLER WITH BRONZE STRIPE

Special Quality Heavy Duty M-H "Superalloy" Rolls, with special alloy composition, heat-treated—developed for use under severe operating conditions in blooming and slabbing mills and similar rolling operations.



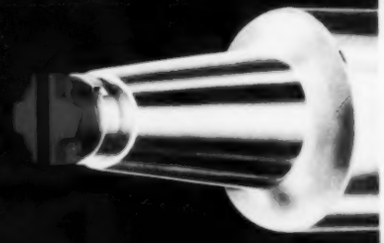
RED WABBLER WITH WHITE STRIPE

"Technisteel" Carbon Steel Rolls—utility rolls for 2-high mills and hand mill operations, where high tonnages are not required.



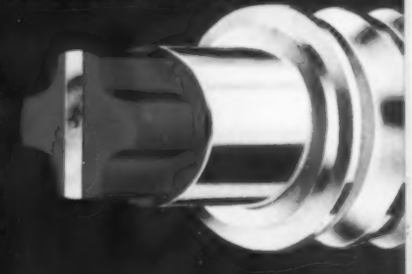
RED WABBLER WITH BLUE STRIPE

Regular Quality Cast Steel "Technalloy" Rolls, with special metallurgical variations—tough-action rolls designed for slabbing, roughing, back-up, non-ferrous cold-breakdown, and other heavy service applications.



RED WABBLER WITH ALUMINUM STRIPE

"Technikrome" and "Stironite" Rolls of High-Carbon Steel—with tensile strength greater than iron, these rolls can be applied to a wide variety of rolling applications such as continuous bar and billet mills and for rolling deep structural sections.



MACKINTOSH-HEMPHILL CO.

Makers of the Rolls with the Striped Red Wabblers

PITTSBURGH AND MIDLAND, PA.

Mackintosh-Hemphill products include:

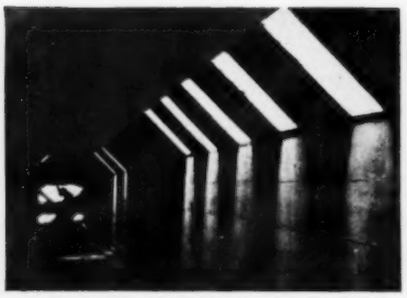
ROLLS . . . STEEL AND SPECIAL ALLOY CASTINGS . . . HOT STRIP MILLS . . . HEAVY DUTY ENGINE LATHES . . . THE NEW MACKINTOSH-ABRAMSEN STRAIGHTENERS . . . IMPROVED JOHNSTON PATENTED CORRUGATED CINDER POTS AND SLAG HANDLING EQUIPMENT . . . SHAPE STRAIGHTENERS . . . SHEARS . . . LEVELLERS

HERE'S LOW-COST PROTECTION

against heat and corrosion in flues or stacks

LUMNITE* REFRACTORY CONCRETE

Inside of Open Hearth Flue. There are no ragged walls or flattened arches. Notice its excellent condition after 5 years of service.



The interior of this waste-gas coke oven flue was built with Lumnite concrete. No lining was needed on this job.

Shooting Lumnite Concrete lining in steel stack. This economical Lumnite lining in stacks protects against corrosion and heat.

Flues are fully protected against heat and corrosion when Lumnite Refractory Concrete is used. Whether used as a monolithic structure or as a lining in flues, Lumnite resists high temperatures and the attacks of condensate and sulphurous gases; withstands the abrasive action of high-velocity gases and fly ash. In stacks, smooth, jointless Lumnite linings allow no breathing, boost drafts and keep gas temperatures up.

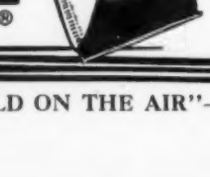
Lumnite Refractory Concrete is easily installed. It may be placed quickly in any size, shape or thickness. Stack linings of Lumnite and corrosion-resistant aggregate are trowelled in place or "shot" by concrete gun over reinforcing mesh. Maintenance costs are low. Outage time for repairs is kept to a minimum because Lumnite reaches service strength in 24 hours or less. Thus long service and easy maintenance give you many a *plus* in economical operation. For further information on Lumnite Refractory Concrete in flues and stacks, write to Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, N. Y.

SPECIFY CASTABLES MADE WITH LUMNITE

Where suitable aggregates are not readily obtainable, tailor-made mixtures, ready for immediate use, are available. These factory-prepared mixtures of Lumnite and selected aggregates, when mixed with water on the job, may be cast into place for furnace door linings, arches, blast furnace pads, annealing furnace car tops and door linings. Special shapes can be cast in molds—ready within 24 hours. Castables made to meet specific temperature and insulation requirements are prepared by manufacturers of refractories and sold by their distributors.

"LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.

IS-L-19



LUMNITE® FOR **REFRACTORY CONCRETE**

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

"TOOL STEEL" PROCESS

TRACK WHEELS FOR OVERHEAD CRANES...

provide

YEARS OF SERVICE AS COMPARED TO MONTHS FOR OTHER MATERIALS!

"Tool Steel" track wheels are providing up to **30 times** the life of ordinary wheels used in the same service!

This amazing superiority is substantiated by our customers' own records.

Investigate these **facts** today. You'll find the same unequalled quality built into other "Tool Steel" parts for cranes, including gears, pinions, brake and sheave wheels, axles and sheave pins!

WE GUARANTEE our products to give sufficient life over any other grade of hardened material operating in the same service to cover any difference in first cost. If our material fails to fulfill this guarantee, we will make good the deficiency in either cash or new material.

THIS GUARANTEE WAS ORIGINATED BY AND IS EXCLUSIVE WITH THE TOOL STEEL GEAR AND PINION CO.

HERE'S AN ACTUAL COMPARISON:

(From the customer's own records:)

WHEELS	AVERAGE LIFE IN MONTHS
High carbon cast	8 to 12
Manganese steel	12 to 18
Hardened rolled steel	16 to 20
"TOOL STEEL"	**over 168***

*After **14 YEARS** of service further records were deemed unnecessary.

This service life can be equalled by no other products!

Write today for complete information.

"TOOL STEEL" PROCESS

The Standard of Quality

for GEARS • PINIONS • ROLLS • WHEELS *and other* HARDENED PRODUCTS

THE TOOL STEEL GEAR & PINION CO.

CINCINNATI 16, OHIO, U. S. A.

The Hagan *Air Operated* System is now providing precision control in these steel mill applications:

- Soaking Pit Control
- Open Hearth Control
- Slab Heating Furnace Control
- Gas Pressure Control
- Gas Mixing Control
- Coke Oven Blower Control
- Coke Oven Exhauster Control
- Coke Oven Cross-Over Control

...because Hagan *Air Operated* Controls are

- Faster
- Cleaner
- Safer
- Easier to maintain

For full applications on the many satisfactory installations of Hagan *Air Operated* controls, write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

HAGAN HALL BUROMIN CALGON

HAGAN CORPORATION

METALLURGICAL FURNACE CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
BOILER COMBUSTION CONTROL SYSTEMS

. . . Boosting your production

. . . cutting your costs

HEPPENSTALL SHEAR KNIVES

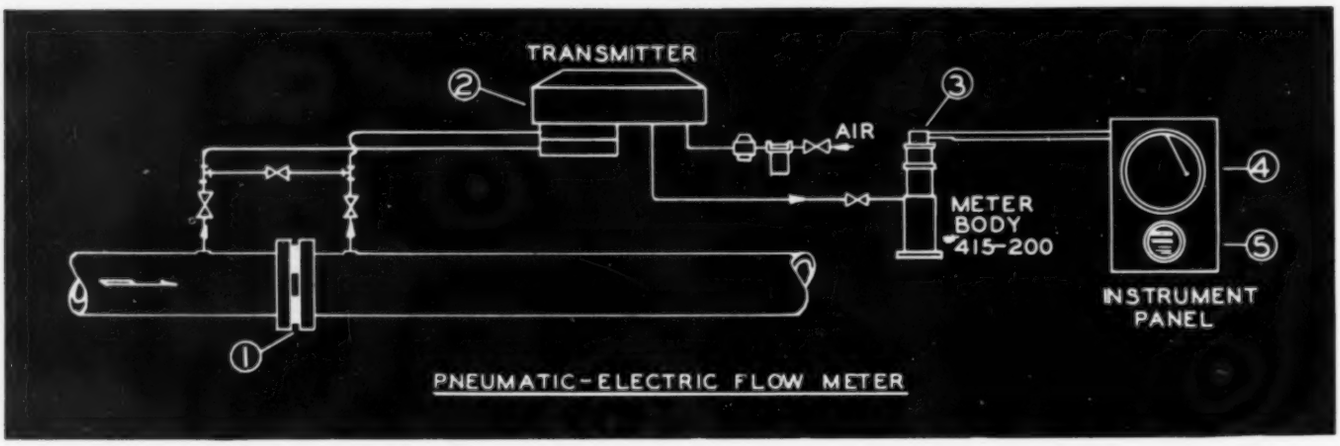
In shearing operations, the superior performance of Heppenstall Knives is recognized in mills throughout the world. Actual service records show that these knives have consistently delivered greater tonnage per edge . . . more and cleaner cuts per grind . . . per knife . . . and per dollar of original cost.

In your mill, too, you can maintain peak production at lowest cost by using Heppenstall Shear Knives—*the finest knives obtainable.* They are forged and rolled from our own electric induction steels . . . heat treated precisely for each specific service application. Why not order a set today and give your shears a chance to prove their true potential?

60th ANNIVERSARY 1889 1949

HEPPENSTALL COMPANY

PITTSBURGH DETROIT BRIDGEPORT



The Answer to Your **OXYGEN** *Metering Problems!*

Here is an oxygen flow metering system that will accurately integrate the rapidly fluctuating flows encountered in steel mill operations.

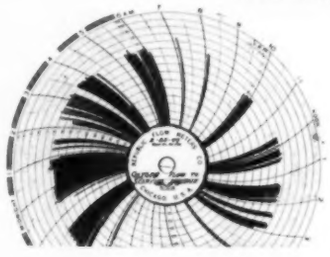
SENSITIVE METERING SYSTEM

The flow metering system, shown diagrammatically above, is a combination pneumatic-electric system for measuring a rapidly fluctuating flow of oxygen. It consists of:

1. ACCURATE ORIFICE METERING
- No moving parts in the flow line.
- No stuffing boxes with grease to develop hazardous conditions.

2. PNEUMATIC TRANSMITTER
- Differential measurement of highest sensitivity.
- Oxygen confined by housing of suitable metals.
- No stuffing boxes.
- Stainless steel or Monel sylphon sealing bellows.

3. AIR ACTUATED ELECTRIC TRANSMITTER
- Converts air loading to electric current flow proportioned to oxygen flow.
- Suitable for electric transmission to distant instruments.
- No moving parts.



Flow of Oxygen to hot scarfing machine. Maximum flow 98,000 cu. ft. per hr. Duration of each flow 15 seconds.

Republic Continuous Integrator

4. OXYGEN FLOW RECORDER
- Equally graduated charts, direct-reading in flow.
- Permanent record of rates of flow.
- Record of time of changes in flow.
- Can be equipped with flow indicator.

5. CONTINUOUS INTEGRATOR
- Accurately follows all sudden changes of flow.
- Not the intermittent type taking spot readings.
- Completely independent of recorder.
- No clock involved.
- Cyclometer counter, plus dial for brief periods.

WIDE RANGE

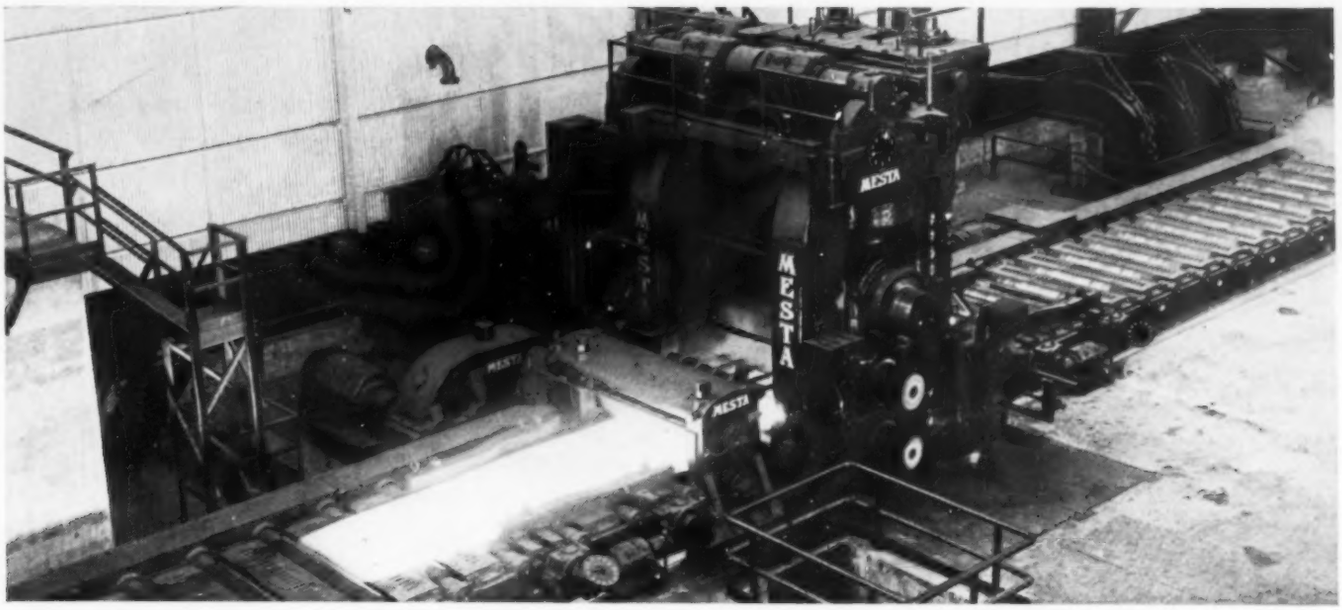
For those installations where wide ranges of flow are encountered, a Republic pneumatic-electric metering system can be installed with a range of approximately 10 to 1. By a special piping arrangement, the range of accurate flow measurement can be extended to approximately 50 to 1.

The Republic pneumatic-electric flow metering system is completely described in Bulletin No. 48-2.

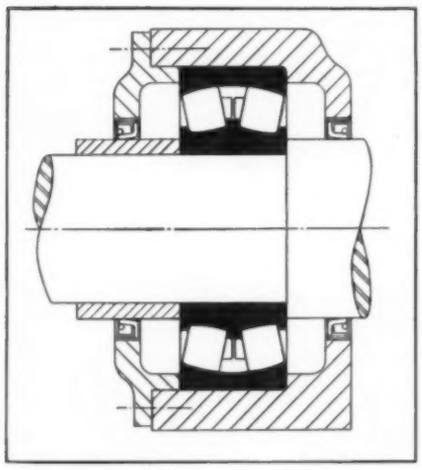
Write for your copy today.

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

Torrington Spherical Roller Bearings keep the mill train running on schedule

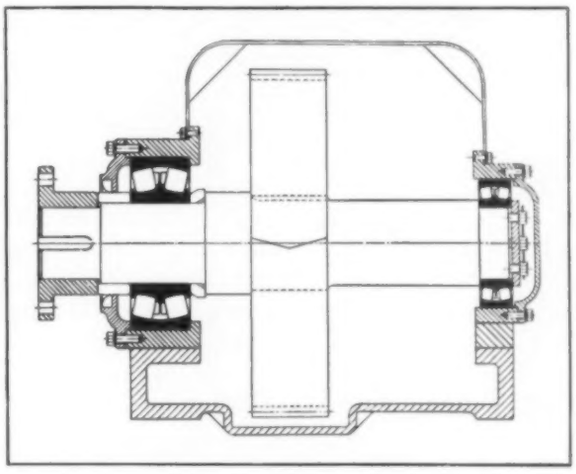


To keep strips of steel running down the mill train on schedule, every piece of equipment has to stay on the job. Heavy loads put severe strain on table rolls, gear drives, pinion stands, take-up reels, coilers, tension rolls, saws, shears and screwdowns. Shock loads can cause shafts to deflect, pinching and jamming rigid bearings and shutting down the train. Mill operators find the surest way to get sustained operation, with automatic alignment under deflection, is to use Torrington Spherical Roller Bearings.



In this table roll mounting, bearings are positioned some distance apart. With rigid bearings, initial alignment is difficult to secure. This Spherical Roller Bearing design automatically assures proper initial alignment.

Or consider this gear drive. The length of the final reduction shaft makes it subject to deflection. When loads are heaviest and deflection greatest, Spherical Roller Bearings maintain the full area of bearing contact surface.



Equip your heavy-duty mill machinery with reliable Torrington Spherical Roller Bearings for "on-schedule" production with minimum maintenance. Our engineers will be glad to help you with design and application. Write us today. THE TORRINGTON COMPANY, South Bend 21, Ind., or Torrington, Conn. District offices and distributors in principal cities of United States and Canada.

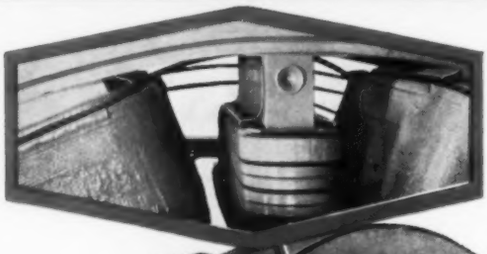
TORRINGTON SPHERICAL ROLLER **BEARINGS**

Spherical Roller • Tapered Roller • Straight Roller

Needle • Ball • Needle Rollers

Elliott [redacted]-STEEL DC Motors stay on the job . .

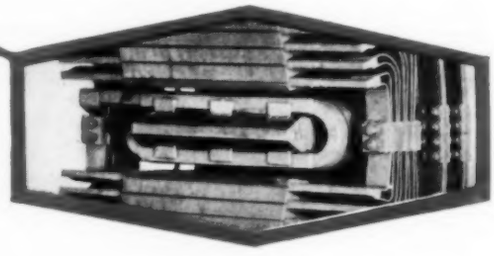
...built with carefully planned rugged construction of each part, enabling them to stay in service without costly and time-consuming repairs.



Coil tighteners compressed between the frame and coils.

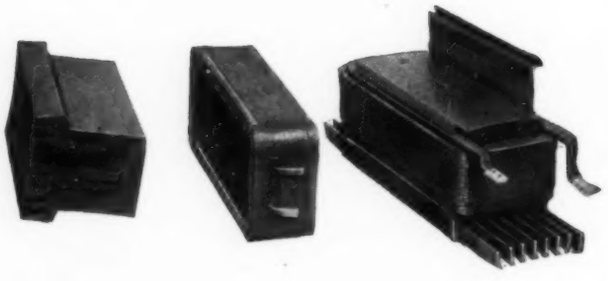
FIELD FRAME—Coils and windings readily accessible for cleaning or maintenance, yet rigidly braced against movement and chafing without resort to the use of cording or wood blocking which deteriorates with age; fully compensated rectangular type bar winding with joints silver-alloy brazed; thick, split frame, of minimum length, gives unusual stiffness and allows better cooling and access to field windings.

Non-magnetic steel fingers welded to commutating pole piece.



MAIN FIELD POLE, COILS, AND COIL TIGHTENERS—Pole insulation built into shunt coil from inside and folded over outside of coil at top and bottom and anchored by turning it under last layer of conductors; top and bottom corners of coils, where not covered by pole insulation, protected with mica corner pieces extending under pole insulation; radial and side movement of coil prevented by pressure of corrugated steel coil tighteners between frame and pole; steel spacers welded to pole ends prevent axial movement.

COMMUTATING FIELD POLE, COIL, AND COIL TIGHTENERS– Conductors insulated from pole by U-shaped channels inserted over each turn from inside coil; canvas phenolic strips taped to top and bottom of coil; radial, axial and side movement of coil prevented by pressure of corrugated steel coil tighteners between frame and non-magnetic fingers welded to inner end of pole piece.



For full details write to DEPT. I-S.

MR-3

ELLIOTT COMPANY Ridgway Division, **RIDGWAY, PA.**

Plants in JEANNETTE, PA. • RIDGWAY, PA. • SPRINGFIELD, OHIO • NEWARK, N. J.

DISTRICT OFFICES IN PRINCIPAL CITIES

Personnel News...

Walter H. Wiewel was named vice president in charge of sales of Crucible Steel Co. of America. Mr. Wiewel, who retains his present post as president of the Crucible subsidiary, Trent Tube Co. of East Troy, Wis., also was elected to the Crucible board of directors at its recent quarterly meeting. He will head all sales activities of Crucible and Trent, and will make his headquarters in Pittsburgh, Pa.

R. S. Poister, vice president and a director of Crucible Steel Co. of America, now is in charge of all manufacturing operations of Crucible. Mr. Poister's chief responsibilities since 1947 have centered in the operations of the plants in Midland, Pa., and Pittsburgh, Pa., and in the large plant improvement program of the company.

M. E. Cummings has been appointed assistant vice president in the operations department of Crucible Steel Co. of America. Mr. Cummings had been assistant to the president since 1945, concerned principally with operations of the Crucible plants in Syracuse, N. Y., and Harrison, N. J. He will make his headquarters in Pittsburgh, Pa.

E. J. Duffy has been named assistant general superintendent of the Kaiser Steel Corp. plant at Fontana, Calif. He returns to Fontana after 17 months as manager of the Kaiser-Frazer Parts Corp. blast furnace at Provo, Utah. He was superintendent of the Fontana blast furnace before he went to Provo. Before his first term of service with Kaiser Steel, Mr. Duffy was employed by Carnegie-Illinois Steel Corp. at Duquesne, Pa.

W. C. Snyder, Jr., vice president in the engineering and construction division of Koppers Company, Inc., since June, 1947, has been assigned to manage the metallurgical department of that division. Since joining Koppers, Mr. Snyder has been Chilean contract manager, guiding Koppers activities near Concepcion, Chile, where the division is supervising the erection, and will inaugurate operation of an integrated steel mill for the Pacific Steel Co. of Chile. In his new position, Mr. Snyder will direct all activities of Koppers engineering and construction division which lie in the metallurgical field. At the same time, Mr. Becker announced the appointment of **Peter V. Martin** as assistant manager of the metallurgical department, and the appointment of **C. A. Kral** as a special assistant who will go to Chile as Koppers Chilean management representative. Mr. Martin has been sales manager for the metallurgical department of the division since February, 1947, while Mr. Kral has been general manager of the Newport Steel Corp., of Cincinnati, Ohio.

Charles E. Sharp has been made Chicago branch industrial manager for Brown Instruments division of Minneapolis-Honeywell Regulator Co. Mr. Sharp, who has been with the Chicago office for the past five years, succeeds **J. A. Robinson,** who has been made regional industrial sales manager for the midwest and all western and Pacific Coast areas. Both men started with the Brown company at its Philadelphia main plant about 20 years ago.

J. C. Fink, formerly manager of the industry engineering department of the Westinghouse Electric Corp., East Pittsburgh, Pa., has been named assistant to the vice president in charge of engineering.

George Perrault, Jr., has been appointed sales manager of the rolling mill division of E. W. Bliss Co. at Salem, Ohio. Mr. Perrault was formerly sales and advertising manager of the Salem Engineering Co.

Robert S. Fleshiem has been promoted from manager of Allis-Chalmers electrical department to assistant to the executive vice president of the company's general machinery division. In his new post, he succeeds **J. D. Greensward,** recently named general manager of the company's Norwood, Ohio, works. **Roy M. Casper,** who has been manager of Allis-Chalmers motor and generator section, becomes manager of the company's electrical department.

Charles E. Stutenroth has been appointed manager of the fabricating division of Armco Steel Corp., Middletown, Ohio, succeeding **J. R. Freeze,** who asked to be relieved of his responsibilities because of ill health.

Walter F. Nicoden, has been appointed assistant general superintendent of Youngstown, Ohio, district

R. S. POISTER

E. J. DUFFY

W. C. SNYDER, JR.

GEORGE PERRAULT, JR

FOR HARD FACING AND REPAIR

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WELDING PRODUCTS

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No. 459

Increases life 2 to 5 times for dippers, pug mill knives, brick dies, shredder knives, drag chain links, pulverizer hammers, sand pumps and similar parts. Amsco No. 459 is centrifugally cast . . . resists softening up to 800° F. . . . and has a Brinell hardness of 500-600. No. 459 produces a chrome-moly martensitic iron deposit and is designed for severe abrasion service with moderate impact conditions.

The application above shows Amsco No. 459 applied to the front and teeth of a manganese steel walking dragline bucket, used for stripping overburden from iron ore at a Minnesota mine. In similar applications where more severe impact coupled with abrasion is encountered, Amsco Economy Hardface is recommended.

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Offices in principal cities. Made and sold in Canada by Canadian Ramapo Division of Joliette Steel Ltd., Niagara Falls, Ont.

works of Carnegie-Illinois Steel Corp. Mr. Nicoden goes to the Ohio plant from his company's Edgar Thomson works, Braddock, Pa., where he has been assistant general superintendent. **Edward J. Parsons,** who has been superintendent of steel production at Youngstown, will succeed Mr. Nicoden at Edgar Thomson works.

E. T. Warren has been appointed vice president of Tata, Inc., New York, N. Y. Mr. Warren has recently returned from India, where he was assistant general superintendent of the Tata Iron and Steel Co., Ltd., at Jamshedpur. Prior to 1938, Mr. Warren was at the Homestead and Edgar Thomson plants of Carnegie-Illinois Steel Corp.

Earl M. Richards, vice president in charge of operations, Republic Steel Corp., Cleveland, Ohio, has been elected vice president in charge of planning and development to serve in an advisory capacity to the company's president on long-range planning and development of raw material sources, plants, facilities and new products. He is succeeded as vice president in charge of operations by **W. M. Kelley,** who for the last four years has been in charge of manufacturing divisions of the corporation. **N. J. Clarke,** senior vice president of Republic, and a veteran of 52 years in the steel industry, will retire December 31. He became a director of the corporation in 1939, and is also a director of several Republic subsidiary companies including Fretz-Moon Tube Co. and Vance Iron and Steel Co.

Frank J. Aschenbrenner and **Earl C. Clark** have been appointed assistant directors of research and engineering for Air Reduction Sales Co., New York, N. Y.

F. D. Weatherholt was appointed manager of industrial sales for Westinghouse Electric Corp., East Pittsburgh, Pa. Mr. Weatherholt was appointed assistant manager of industrial sales at East Pittsburgh in 1948.

Samuel B. Applebaum was appointed manager of the cold process water treating division of Cochrane Corp., Philadelphia, Pa. He is also vice president of the Liquid Conditioning Corp., an operating subsidiary of Cochrane. Mr. Applebaum was formerly vice president of the Permutit Co. and later president of Liquid Conditioning Corp.

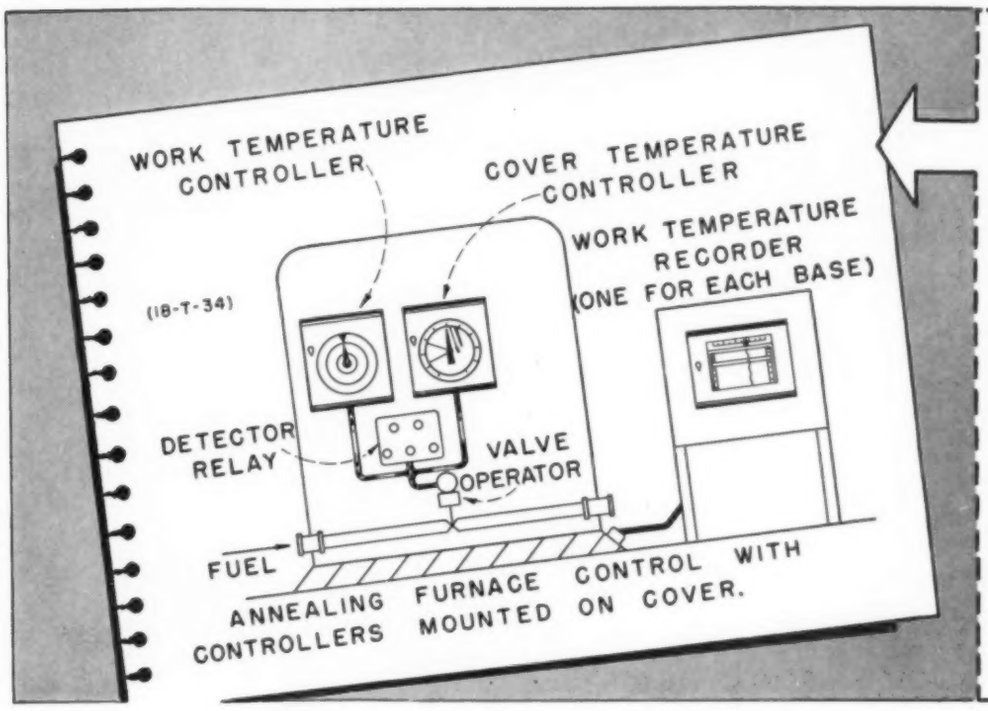
Alfred E. Giblin has been named assistant plant manager of the Wickwire Spencer Steel division, Colorado Fuel & Iron Corp., at Buffalo, N. Y., succeeding **Graham W. Wickizer,** who has returned to the company's Pueblo, Colo., plant. Mr. Giblin had formerly served as mason-labor department superintendent. **J. Wilbur Campbell** has been made superintendent in charge of wire operations at the Buffalo works, succeeding **A. J. LaBlanc,** who resigned. Mr. Campbell had been assistant superintendent of the wire mill.

Will L. Corbett was appointed to a newly-created post of assistant to the district manager of American Steel and Wire Co., Pittsburgh, Pa. Mr. Corbett, formerly superintendent of industrial relations at the Waukegan, Ill., plant of the same U. S. Steel subsidiary, will serve on special assignment in his new post.

New Simplicity
for Annealing Cover Control

...WITH

Brown ElectroniK Continuous Action Control Systems



The *ElectroniK* Controllers *may be mounted right on the cover . . . their sensitivity is unaffected by vibration and severe ambient temperature conditions.*

An *ElectroniK* Multiple Strip-Chart Recorder *may be provided for each base . . . assuring accurate and continuous record of each work thermocouple, without switching panels.*

REPRESENTATIVE of the new simplicity desired for all metal processing operations are the new Brown *ElectroniK* Control Systems for Annealing Covers.

Continuous control is provided for both work and cover temperatures. Systems vary only according to method of firing and mounting temperatures . . . all possess the same fundamental simplicity . . . all continuously control cover and work temperatures.

The advantages of such simplification . . . greater production, precision, economy . . . warrant your investigation. Write, today, for details . . . or call in your local Brown engineer.

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BROWN INSTRUMENTS DIVISION
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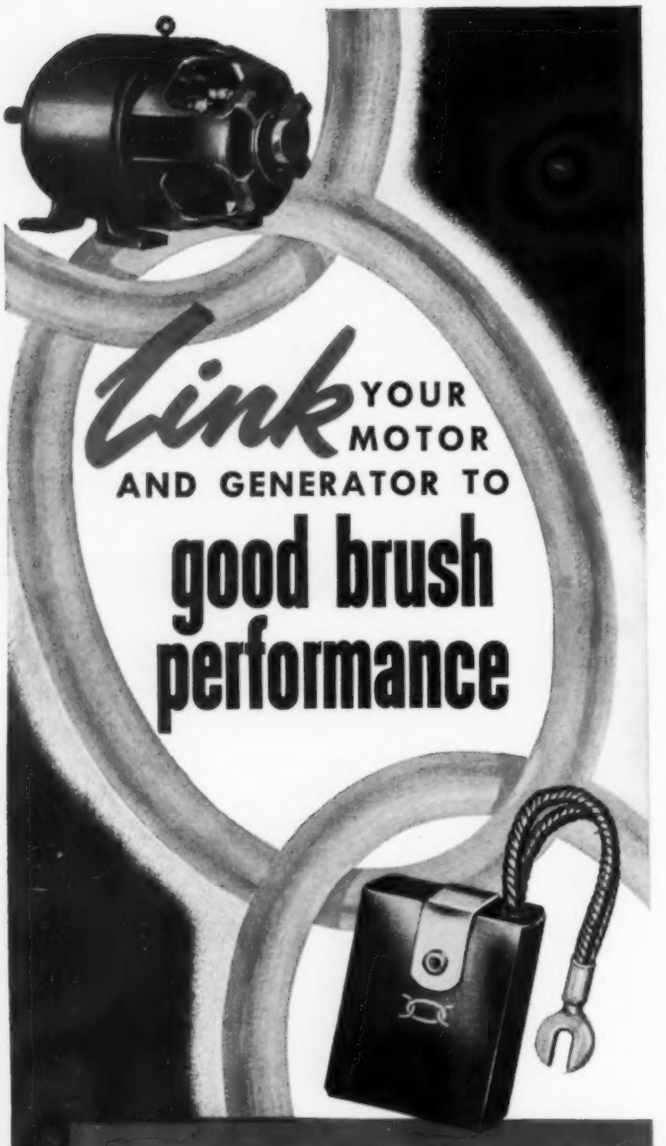
MINNEAPOLIS Honeywell — *Advanced Instrumentation* FOR METAL PRODUCING — BROWN INSTRUMENTS



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CARBON BRUSHES

Using Morganite Brushes is one sure way to better motor and generator performance. The Morganite *link control* method of manufacture guarantees proper design, highest quality materials and accurate workmanship. Morganite engineering service assures competent, practical collaboration on every brush problem.

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LONG ISLAND CITY 1, NEW YORK

Manufacturers of Morganite Self-Lubricating Carbon Specialties including Seals, Rings, Valves, Slides, Bearings, etc., and Carbon Piles

Robert L. Craig, for 15 months supervisor of apprentice training in the Youngstown district of Youngstown Sheet and Tube Co., has been appointed supervisor of employment for the company's Youngstown area. He succeeds **Carl M. Ott** who died June 26.

W. D. MacDonnell was named assistant general manager of the Johnstown, Pa., plant of Bethlehem Steel Co. Mr. MacDonnell succeeds **H. M. Crossett,** who is retiring. Mr. MacDonnell is a graduate of Massachusetts Institute of Technology. He entered Bethlehem's loop training course in 1934 and was assigned to the Lackawanna, N. Y., plant. After holding a number of responsible positions he was appointed assistant to the general manager in 1946. In the following year he was named assistant superintendent of open hearths and in 1948 he became superintendent.

R. Russell Fayles, who went with Lukens Steel Co., Coatesville, Pa., in 1941 as open hearth fuel engineer and who subsequently became assistant to the open hearth superintendent, has been named fuel engineer of the company in place of **Henry S. Hall,** who has resigned. Prior to his association with Lukens Steel Co., Fayles was for four years assistant fuel and power engineer at the Vandergrift works of Carnegie-Illinois Steel Corp., and for one year as special engineer at South Chester Tube Works, Chester, Pa.

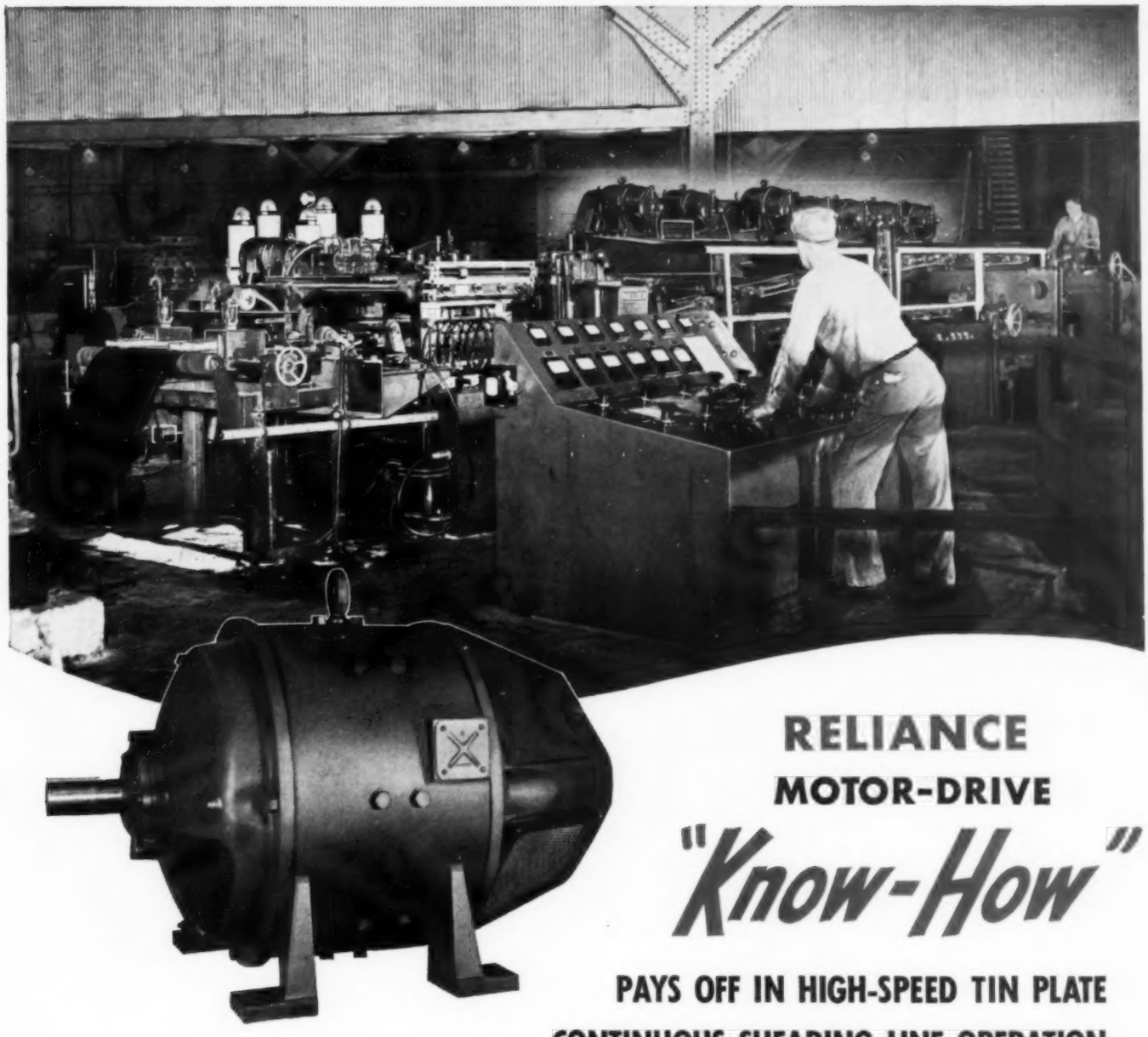
R. RUSSELL FAYLES

J. A. Creighton, superintendent of No. 1 open hearth at the Lackawanna, N. Y., plant of Bethlehem Steel Co., has been appointed superintendent of open hearths. **J. L. Walton,** assistant superintendent of No. 1 open hearth, was named superintendent of No. 1 open hearth.

Benjamin S. Sampson was appointed manager of the industrial furnace and oven division of the Claud S. Gordon Co., Chicago, Ill.

W. J. Howell was appointed as assistant to the manager of apparatus sales for the Westinghouse Electric Corp., Pittsburgh, Pa.

Clyde L. Hassel was elected a director and president of the Pittsburgh Engineering and Machine Co., a subsidiary of Pittsburgh Steel Foundry Corp. Mr. Hassel has been vice president in charge of sales and engineering of the Pittsburgh Steel Foundry Corp., and will continue in this capacity along with his new duties with the Pittsburgh Engineering & Machine Co.



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MOTOR-DRIVE
"Know-How"
PAYS OFF IN HIGH-SPEED TIN PLATE CONTINUOUS SHEARING LINE OPERATION

RELIANCE V★S SYSTEM

High output and low unit cost are made possible by synchronized electric motor-drives which provide smooth acceleration, high production speeds and continuous running at those speeds. In the high-speed tin plate shearing line, shown above, the motor-drive embodies the experience gained by Reliance through more than forty years of process line drive development. Reliance motor-drive 'know-how' is in evidence throughout the steel industry in cleaning, pickling, tinning, slitting, shearing and related continuous process operations. It will pay you, too, to consult a Reliance application engineer.

Sales Representatives in Principal Cities

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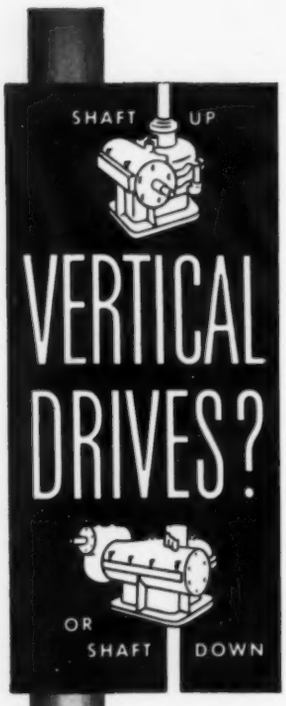
A complete line of De Laval vertical speed reducers, in both single and double reductions, is available for driving agitators, mixers, and many other types of vertical shaft equipment.

If vertical drives are your problem, consult De Laval.

*This single reduction De Laval Worm Gear Reducer is available with many standard gear ratios and is but one of the 93 sizes and types of standard De Laval Worm Gear Speed Reducers.



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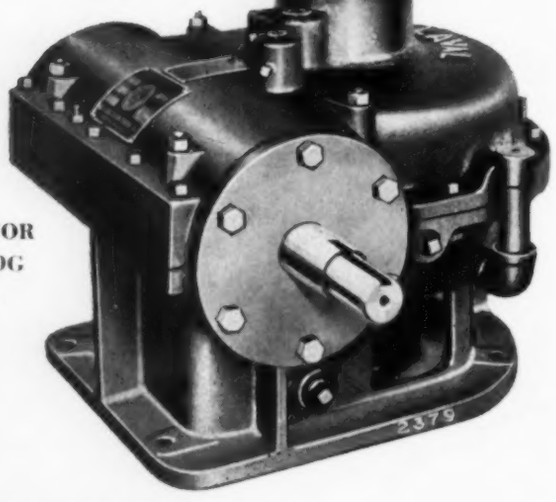

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Worm Gear Division

DE LAVAL

De Laval Steam Turbine Co., Trenton 2, N. J.

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS
CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

Samuel Horelick, who for the past 20 years has been president of the Pennsylvania Transformer Co., was

SAMUEL HORELICK

elected to the newly created position of chairman of the board. **W. E. Kerr,** who has been vice president and

W. E. KERR

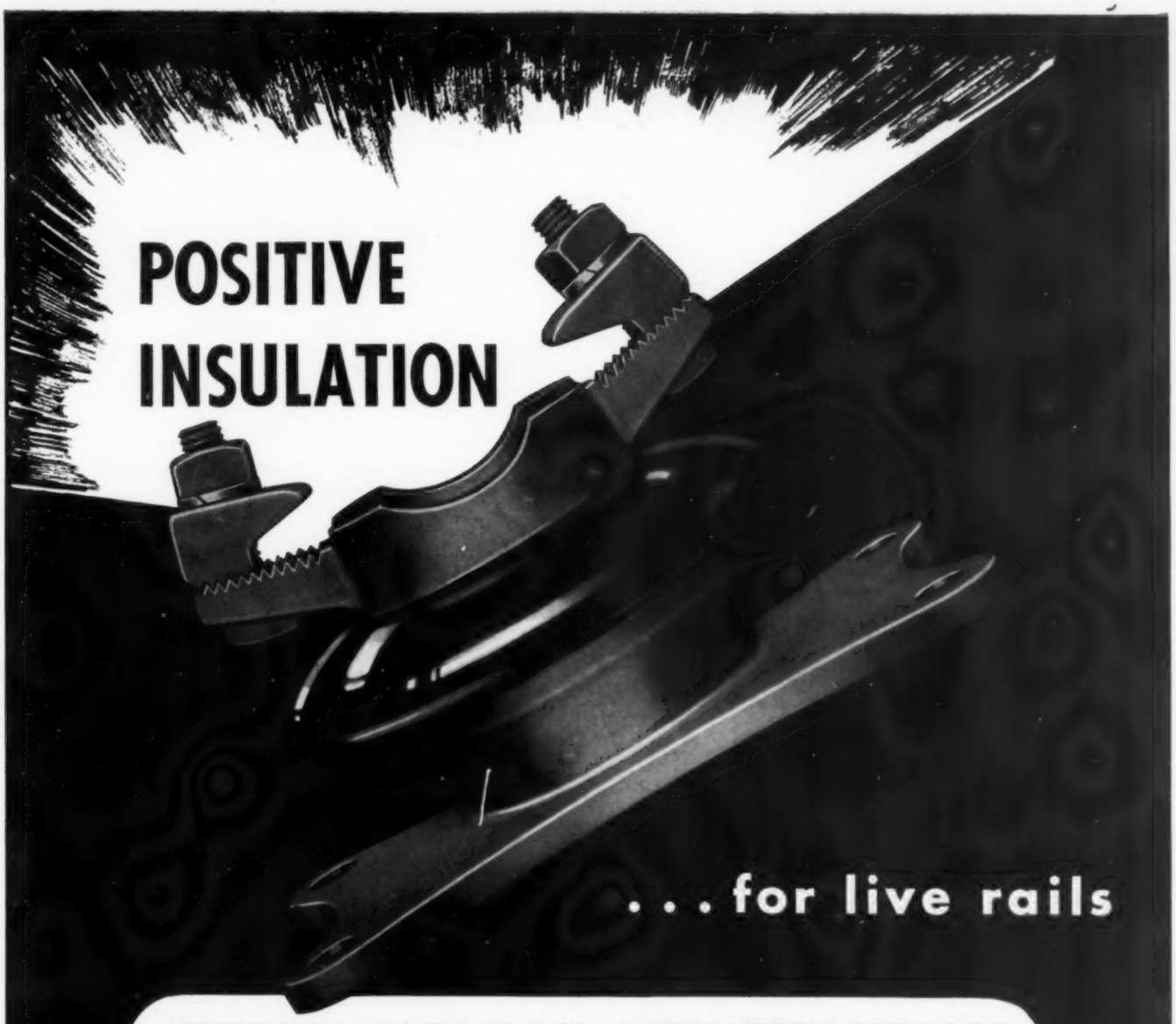
treasurer since the company was organized in February 1929, was elected president. **W. R. Swoish,** sales manager, was elected vice president; he will also continue as sales manager.

E. W. Chapman was appointed assistant sales manager and **S. N. Morison** as manager of industrial sales for S. G. Taylor Chain Co., Hammond, Ind.

George E. Gilliam will manage pyrometer supplies sales nationally for Brown Instruments division of Minneapolis-Honeywell Regulator Co. Mr. Gilliam has been with the company for the past five years, most recently at its South Bend, Ind., branch office. He will make his headquarters at the company home office in Philadelphia, Pa.

L. B. Dobbins has been appointed supervisor of plant engineering for Air Reduction Sales Co., New York, N. Y.

Thomas M. Chalmers has joined Blaw-Knox Co., Pittsburgh, Pa., as engineering consultant on steel mill equipment. Mr. Chalmers was formerly vice president in charge of operations of Tennessee Coal, Iron & Railroad Co. at Birmingham, Ala. He will devote special attention to rolling mill machinery produced by the company's Lewis division.



KEYSTONE CONTACT RAIL INSULATORS SUPPORT CONDUCTORS IN HEAT, SLEET, AND SNOW

From the high temperatures near soaking pits to constant exposure in rain, sleet, or snow—Keystone Contact Rail Insulators provide constant insulation and allow for expansion and contraction of contact rails.

Type BOA, shown here, is designed for over-running service . . . at voltages below 750 . . . where unusual mechanical strength is required. Its heavy glazed wet porcelain block provides unfailing support and insulation. All metal parts are hot galvanized. Clamps are designed to permit free movement of rails. Easy to install, Type BOA is the perfect answer to rail insulation problems in steel plants across the country.

For your cranes, conveyors, and other electrical hoisting and hauling systems, Electric Service manufactures a complete line of insulators, collectors, and rail shoes . . . used with rails, angles or wires as a conductor. Details on the complete line are available in our free, 300-page illustrated catalog. Write for your copy today.

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COLLECTORS · RAIL SHOES · RAIL INSULATORS · CABLE STRAIN CLAMPS · SHOP TOOLS

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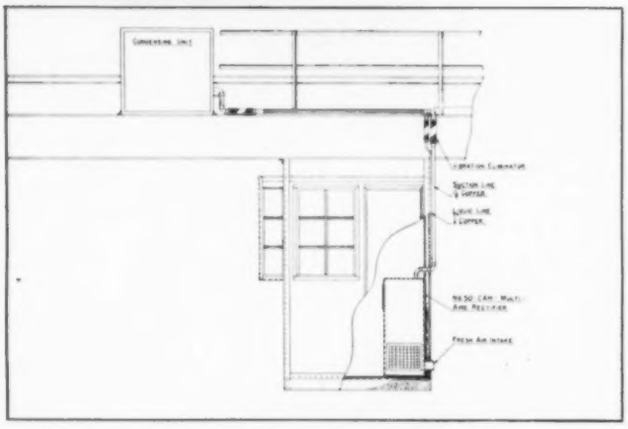

1950 MODELS
LINTERN
Aire-Rectifier

The 1950 models of the "Little Giant" split system Aire-Rectifier now in production involve significant reductions in size and weight, yet with no sacrifice in capacity. Consequent savings in production are passed along to the buyers.

There are three new models in this series: AC 50-13 of 13,000 BTU capacity; AC 50-18 of 18,000 BTU capacity; and AC 50-27 of 27,000 BTU capacity. Typical of the saving in size and weight is AC 50-13. Its condenser unit measures only 38" long, 17" deep, and 35" high — weight, 700 lbs., as compared with the previous model, which measured 57" long, 23" deep, and 49" high — weight, 1,420 lbs.

The control panel is now located in the cab and easily accessible along with thermostats and control switch. Thus all electrical equipment is protected and gives longer operating life.

The split system offers several definite advantages. (1) Reduced engineering costs. (2) Big savings by elimination of expensive, efficiency-reducing air ducts. (3) Higher cooling efficiency in the cab. (4) Greater flexibility in location of all equipment. (5) Lengthened life of operating equipment because of protection from excessive radiant heat and greater accessibility for service. (6) Location of Aire-Rectifier on existing cranes without moving any equipment. Savings run from $1,000 to $2,500 per installation.

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THE LINTERN CORPORATION
54 LINCOLN AVENUE • BEREA, OHIO

Harry T. Graham was appointed to the position of assistant general sales manager of General Refractories Co., Philadelphia, Pa. Mr. Graham has been with General Refractories since 1937, following three years as tax administrator for the federal government. As-

HARRY T. GRAHAM

signed first to the Chicago sales office, he was transferred in 1946 to the home office in Philadelphia. In 1947 he became assistant district sales manager of the Pittsburgh office.

J. F. Hirshfeld is now general manager of the electronic division of the Hinchman Corp., Detroit, Mich. Mr. Hirshfeld was formerly chief engineer of the Stran-Steel division of Great Lakes Steel Corp.

C. C. Bray has been appointed regional supervisor of the new midwestern district office recently opened

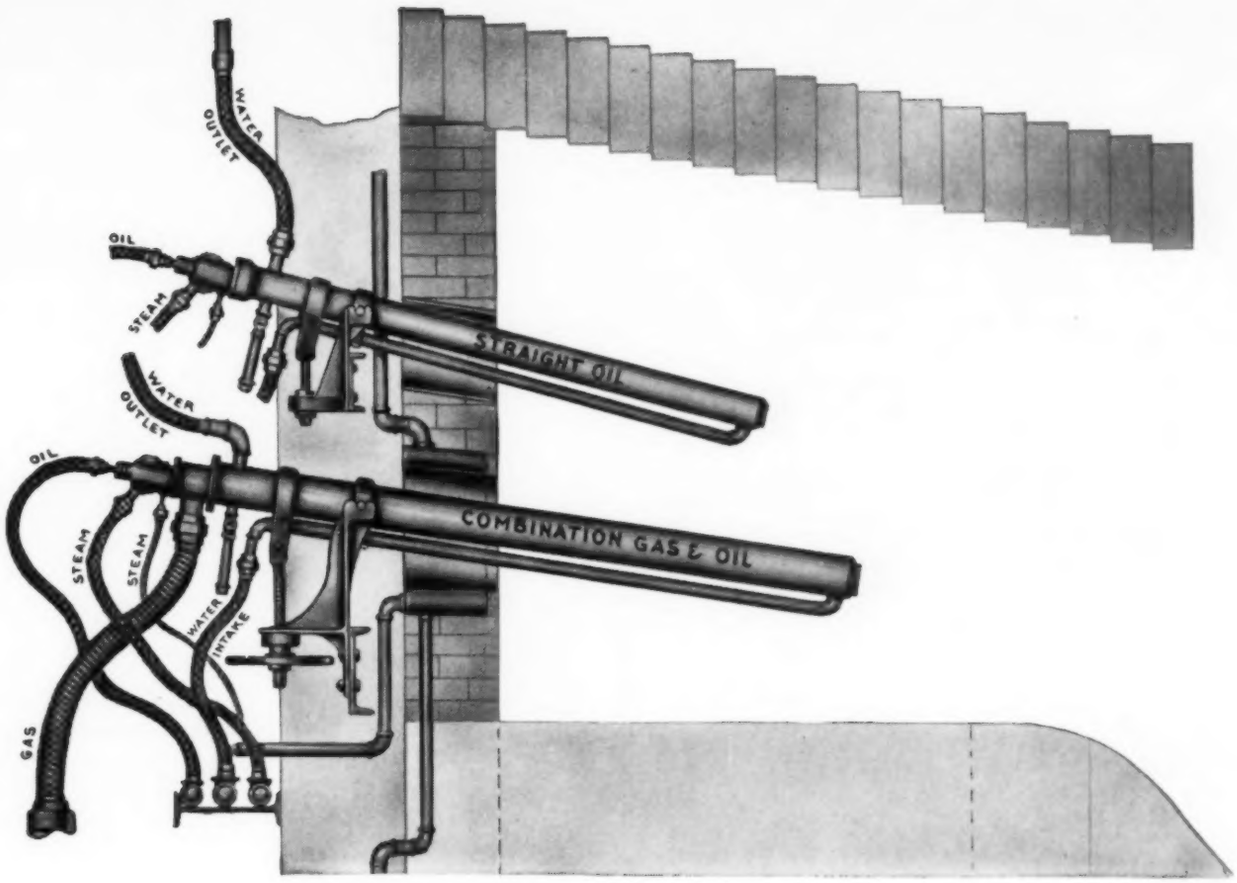
C. C. BRAY

by the De Laval Steam Turbine Co. The new office is located at 1500 South Western Ave., Chicago 8, Ill.

John D. Tebben was appointed sales representative for Gas Machinery Co. in Detroit and Michigan. Headquarters will be at 20869 Mound Road, Detroit, Mich.

J. J. Enochs was appointed as sales engineer in charge of the Pittsburgh area office of Dowell, Inc., with headquarters in the Grant Building, Pittsburgh, Pa.

F. S. Mott was named manager of manufacturing at the Ridgway, Pa., plant of Elliott Co. Mr. Mott was formerly assistant to vice president in charge of manufacture at Master Electric Co., Dayton, Ohio.



CROWE DUPLEX ARTILLERY WATER COOLED BURNERS

Crowe Duplex Artillery Water Cooled Burners, being used in many furnaces throughout the industry, make large melts quickly. Advantages derived from these installations are quicker meltdown with less fuel, and great reduction of furnace erosion.

Top burner uses straight oil when melting down and is turned off as soon as melt is under cover. Bottom burner continues working the heat with oil and gas, or oil alone, until completed.

Burners are built to fit the furnace in which they are to be used. Complete atomization of oil is developed in the Crowe Artillery Water Cooled Burner, effecting big economies in fuel and steam.

The Crowe Artillery Water Cooled Burner does not require protective brickwork and eliminates the necessity of building and maintaining expensive doghouses with the consequent heat loss they cause.

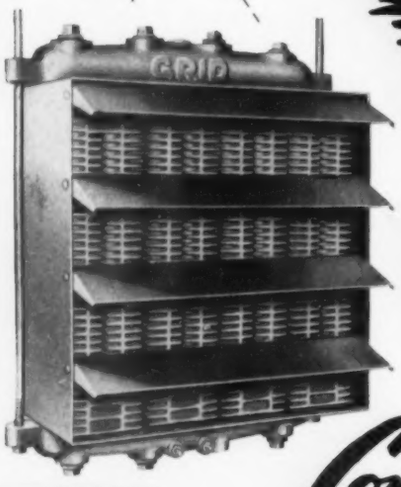
The many exclusive features embodied in Crowe Artillery Water Cooled Burners give results far beyond expectation. Let us supply you with further information and allow us to furnish, at no cost to you, a layout showing burners fitted to your furnace.

THE CROWE ENGINEERING CO.

1838 Western Avenue **Cincinnati 14, Ohio, U.S.A.**

BY ALL MEANS
LOOK INSIDE
THE CASING !!

SEE WHAT YOU'RE GETTING



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HIGH TEST CAST IRON CONDENSER SECTIONS

YOU'RE SURE THAT THEY WILL STAND SEVERE SERVICE WITHOUT MAINTENANCE...

Gentlemen:

We have in service GRID Unit Heaters type No. 2500. A number of them have been in use for approximately 10 years and some of the units are on very severe service where the steam is turned on and off several times each day, the valves being turned on and off very rapidly. Even under this severe service we have found them to be maintenance-free.

Yours very truly
A MIDWEST STEEL MILL

Not only do GRID Unit Heaters stand up in service where steam is turned on and off several times each day—but even then they are maintenance-free while doing an efficient heating job. GRID Unit Heaters are designed to save fuel cost, too, because they provide heat where it is most needed—to the working zone. Careful selection of fans and motor speeds eliminates stratification of warm air at ceiling level . . . GRID Unit Heaters are designed for low outlet temperatures and greater air delivery to the floor line —**not the ceiling,** regardless of atmospheric conditions. GRID Unit Heaters are especially adaptable for cleaning rooms or any part of your mill where acids are used in process work . . . they withstand high corrosive atmospheres without maintenance. All steel mills using GRID Unit Heaters say "GRID is the best for us". Here's why—GRID "fin" heating sections are ONE piece construction high test cast iron—the metal for permanency . . . no electrolysis to cause corrosion, breakdowns, leaks or heating failures, because there are no dissimilar metals used in GRID construction. GRID Unit Heaters will withstand steam pressures up to 250 lbs. Investigate the GRID system of steel mill heating. It's different and time proved.

IT WILL STAND UP TO 250 LBS. STEAM PRESSURES

Write today for the complete GRID story CUH-849-ISE, capacity tables and engineering data.

D. J. MURRAY MANUFACTURING CO.
WAUSAU • WISCONSIN

Peter Robertson was named assistant vice president in charge of operations in Republic Steel Corp.'s manufacturing divisions. Mr. Robertson for the past year has been assistant to the manager of Republic's Cleveland steel district. Prior to that he was works manager of the Youngstown plant of Truscon Steel Co.

John E. Stukel, Jr., former assistant professor at Carnegie Institute of Technology, Pittsburgh, has joined the operating department of Youngstown Sheet and Tube Co., Youngstown, Ohio, as a development engineer. Mr. Stukel is working at present in the office of Dr. Karl L. Fetters, special metallurgical engineer, in Youngstown.

Gilbert W. Chapman was elected president of Yale & Towne Manufacturing Co., New York, N. Y. Mr. Chapman who has been serving as vice president in charge of finance, succeeds **Calvert Carey** as the sixth president of the 81 year old lock and materials handling equipment company. Mr. Carey resigned because of ill health.

Obituaries

Earl C. Souder, for 20 years an industrial sales engineer in the steel mill section at Westinghouse Electric Corp.'s Pittsburgh plant, passed away in Baltimore recently. Mr. Souder has been in the continuous employ of Westinghouse since immediately following the first World War. During this time he has worked with many of the steel companies.

Emil Gathmann, Sr., 76, of Gathmann Engineering Co., Catonsville, Md., died August 23. Mr. Gathmann invented many processes used in the metals industry. He also was the inventor of the depth charge which helped make possible the Allied victory over the German submarines in World War I.

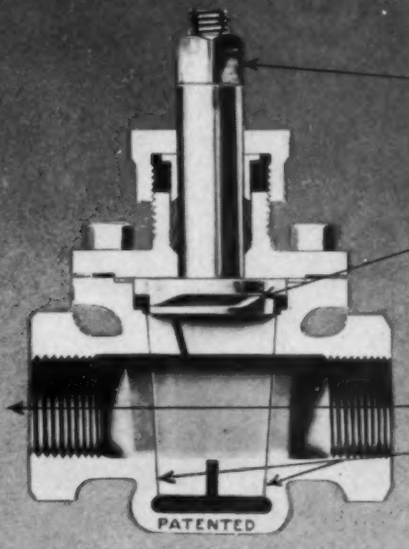
George C. Chartener, night foreman, roll shop, Tennessee Coal, Iron and Railroad Co., Fairfield, Ala., died July 5.

William Elliston Farrell, 79, founder and chairman of the Easton Car & Construction Co., Easton, Pa., died August 22. Born in Nashville, Tenn., on February 7, 1870, Mr. Farrell attended public schools there and the Webb Brothers School at Culleoka, Tenn. At seventeen he enrolled at Vanderbilt University, taking his post-graduate degree of mining engineer in 1891. Mr. Farrell started as a blast furnace chemist for the North Branch Steel Co. of Danville, Pa. After four years with North Branch he joined the Philadelphia Roll & Machine Co. and was appointed general manager of that company in 1898. In 1900 he went to the Birdsboro Foundry & Machine Co. at Birdsboro, Pa., as general manager. Five years later he joined the Treadwell Engineering Co. at Lebanon, Pa., serving as general manager and vice president. He assisted in planning the new Treadwell plant at Easton, and went there as general manager and vice president. Mr. Farrell started in business for himself in 1912, opening an office as a manufacturer's representative in Easton. A year later he purchased the manufacturing business of Ernst Weiner & Co., and in 1914 incorporated this business as the Easton Car & Construction Co. He served as president of his company until 1946, when he became its chairman.

Preferred for over 50 Years for . . .

LOW FIRST-COST
LOW MAINTENANCE
LONG SERVICE

and Quick, Positive Operation



1. Quarter-Turn fully opens or closes.

2. Cam serves as positive stop, and automatically seals valve against leakage by pressing seating surfaces firmly together.

3. Straight-line fluid flow. Minimum pressure drop.

4. Seating surfaces protected in both open and closed positions.

5. Homestead Cam-Seald Quarter-Turn Valves are made in straight-way, 3-way and 4-way types, and in metals for most valve needs; for pressures to 3,000 pounds, and temperatures to 750° F.

Besides being the most economical, maintenance-free, long service valves for handling air, water, gas, oil and other fluids, Homestead Quarter-turn valves are unsurpassed for quick, positive operation. A simple quarter-turn fully opens or closes them; and the patented Homestead cam holds seating surfaces in contact at all times. Seating surfaces are protected in both the open and closed positions so that corrosive fluids or grit cannot cause damage and valve failures. Straight, unobstructed fluid passage assures "full flow" and minimum line pressure drop.

To these important features add the rugged construction typical of all Homestead valves and you have the reason why hundreds of plants in all types of industry have insisted on Homestead Cam-Seald Quarter-Turn Valves for half a century.

HOMESTEAD Cam-Seald QUARTER-TURN VALVES

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QUICK DELIVERY that will SATISFY unpredictable needs of....

COOLING PLATES
HOT BLAST VALVES and SEATS
COOLERS-TUYERES
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based on 60 Continuous Years of "Know How"

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Have you a metal-cleaning "tough nut" ... to crack?

Is it the removal of:

- oils or greases?
- buffing compound residues?
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- lime scale or mill scale?
- carbon smuts?
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- tarnish or rust?
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Or is it preparation for:

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Double Fibre Bridge Assembly
Increases Strength 10 Times

WARE HI-LAG Fuses have the strongest, most rigid knife blade assembly ever designed in fuses. The two heavy fibre bridges are supported by sturdy brass brackets which add greatly to the strength of the assembly. These bridge supporting brackets are attached to the copper knife blades and contact the entire end of links so that current flows through the brackets as well as the blades over a large area. Another reason for WARE HI-LAG Fuse's cool operation.

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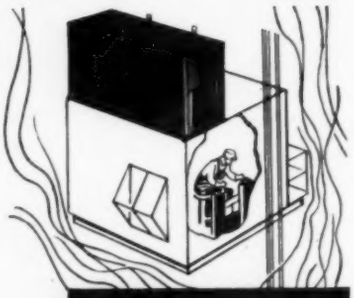

DRAVO CRANE CAB COOLERS

REPEAT ORDERS from steel, iron and non-ferrous metal producers offer proof of the outstanding results where Dravo Crane Cab Coolers reduce fatigue and improve operator performance. It's worth your while to call or wire Dravo for case history details of these applications.

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in COVER-TYPE FURNACES

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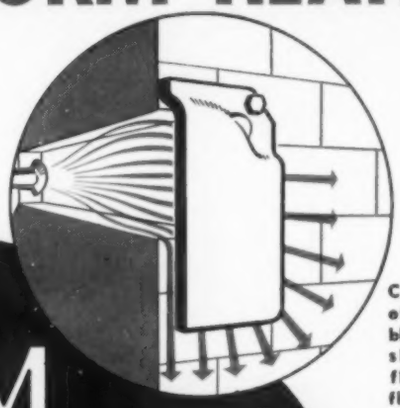


Cutaway view of burner, port block and baffle, showing how flame is deflected.

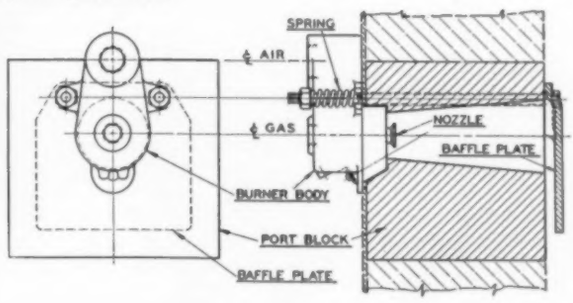
BLOOM

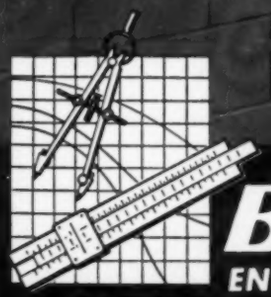
Baffle-Type

BURNER

Flame is deflected horizontally and downward, forming a sheet of flame across lower part of furnace wall. The Baffle prevents direct impingement of flame on inner cover. Concentration of heat at the bottom of the furnace assures fast, uniform heating of the entire charge. After one year of continuous operation, the Baffle Plate shows no deterioration.

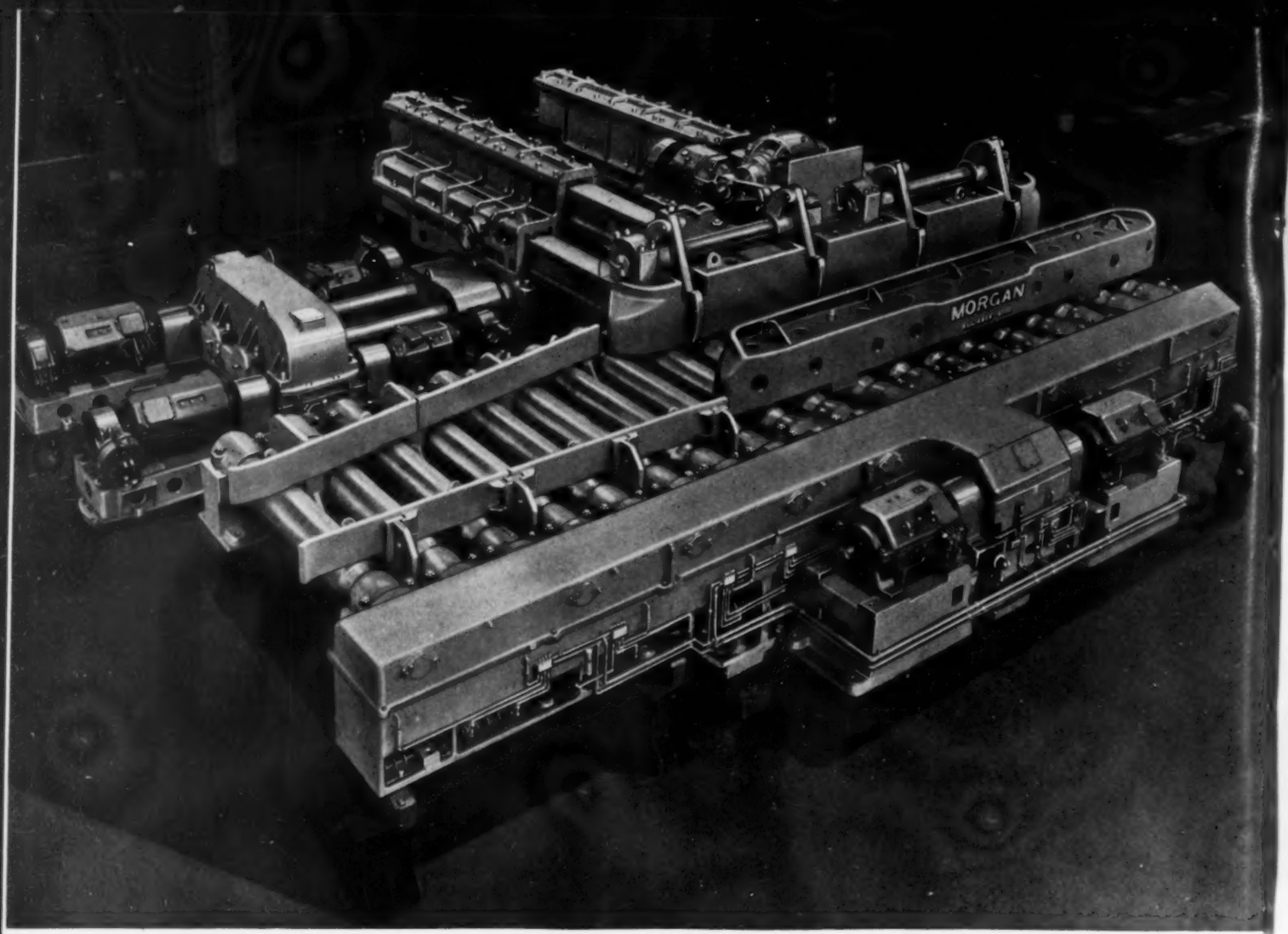
The result: greater production, improved quality, less maintenance.





BLOOM
ENGINEERING CO., INC.
857 W. North Avenue Pittsburgh 12, Pa.

Send for Descriptive Bulletin giving complete details.



45″ BLOOMING MILL TABLE AND MANIPULATOR

Morgan 45″ Blooming Mill Manipulator with Front Mill Table. Manipulator is of the overhead type, electrically driven, with retractable heads so the table rollers can be removed without dismantling the manipulator heads. Table girders are of cast steel box section type with integral oil trough on drive side. All gears are totally enclosed, operating in oil, and have hardened teeth. All bearings are of the anti-friction type lubricated through a centralized motor operated system.

BUILT BY MORGAN Engineering

THE MORGAN ENGINEERING CO.

DESIGNERS • MANUFACTURERS • CONTRACTORS • BLOOMING MILLS • PLATE MILL
STRUCTURAL MILLS • ELECTRIC TRAVELING CRANES • CHARGING MACHINES • INGOT STRIPPIN
MACHINES • SOAKING PIT CRANES • ELECTRIC WELDED FABRICATION • LADLE CRANES • STEA

Equipment News...

SPECTROGRAPH USED TO IDENTIFY CONSTITUENTS OF BOILER SCALE

▲ The usual chemical method of analyzing boiler scales, deposits or other materials is time-consuming—a serious disadvantage in the frequent instances that demand speed. Accordingly, to supplement it with a faster technique, identification experts of Hall Laboratories, Inc., Pittsburgh, now are using the spectrograph in the solution of water problems—a relatively new application of this scientific tool.

As a result, they can identify constituents of a deposit within hours or even minutes. Thus in many cases the cause of a boiler tube failure may be ferreted out quickly without requiring days.

The sample is "burned" in a direct current arc, where the intense heat (5,000-10,000 F) breaks down practically all compounds into their elements. Most of these are gases at such temperatures, and give off light of definite, sharp wave lengths. These are "sorted out" by the spectrograph, so that they are observed as a series of lines of different colors, or are recorded on photographic film for later study. Each element has characteristic lines which permit it to be identified even when present in a mixture of many substances.

For the major constituents of a boiler scale, deposit or other material under investigation, the Hall "laboratory detectives" believe that chemical analysis is probably unequaled as to accuracy in determining proportions or quantities. However, they point out that the spectrographic method permits quick identification of even minute or "trace" metallic constituents.

These, despite their near-absence, oftentimes have a vital bearing on the boiler water conditioning problem at hand.

Also, as a supplement for other laboratory tools, the spectrograph can establish the absence of elements from a material, so that the chemists making separations can ignore these substances as potential constituents, and concentrate their investigation elsewhere.

The spectrograph does not identify compounds as such, but rather some of their constituent elements. For this reason it does not replace, but rather complements, the other laboratory tools and techniques—chemical analysis, x-ray, microscope—employed by these water conditioning consultants in their service work for Hall clients.

The sample is burned in a d-c arc where intense heat breaks down the compounds into their elements.

DUAL ROLL TURNING CAN REDUCE COSTS

▲ Exceptional production savings of 40 to 100 per cent are reported for machining steel mill rolls by a new method of duplicating which converts standard engine lathes to semi-automatic operation.

Known as dual turning, this new technique was originated by the Turchan Follower Machine Co. It produces superior results in speed, accuracy and finish in the handling of any size roll. Work shapes are developed from a model or template by means of a hydraulically controlled cutting tool.

A cross slide equipped with 2 compounds mounted at 45 degrees to center line of the lathe and 90 degrees to each other, replaces the conventional cross slide arrangement, thereby permitting a new combination of movements. Tool approach to the work is doubled. All tracer movements are at 45 degrees to center lines of machine; mechanical movements at right angles.

Maximum rigidity and smoothness are possible as the tracer controlled movements are mounted to the cross slide, giving the job of holding and guiding the tool only to the hydraulic controls, while the mass of the carriage is moved through the lead screw. This allows full concentration of power to obtain a perfect reproduction of the template. Close accuracies are further aided by the short flexible connections between metering valves and actuating pistons, assuring more positive displacement of fluid.

Job set-up time on lathes equipped with Turchan controls can be greatly reduced because of the simplified tooling.

Turchan dual turning accurately machines square shoulders and tapers on right or left side just as easily as straight work, grooves and radii. To change from one angle slide to the other, a single selector valve is provided within easy reach of the operator.

The size of roll to be turned and rate of removing stock is limited only by the capacity of machine and tools. Whenever desired the hydraulic controls can be quickly disconnected, and the lathe returns to conventional operation.

The combination of precise, yet

A new method of duplicating converts standard lathes to semi-automatic operation.

Elimination of large tool inventories is most important.

rugged, fool-proof tracer controls, tools well supported from holder to carriage, roll work piece mounted between journals. Along with the separate movements of tracer travels from mechanical travels, provides an arrangement that literally revolutionizes turning of steel mill rolls.

The elimination of a large inventory in costly form tools by this method is a point of importance. Only a half dozen standard carbide tools are needed to achieve the many hundreds of shapes required of roll turning. Another saving is effected in the re-use of templates. When a roll needs recutting, the template previously used will duplicate the original contours, and without chance of operators errors, so often experienced by usual methods.

RADIOACTIVE ISOTOPES USED FOR MEASURING

▲ Tracerlab, Inc. announces the SM-3 Beta Gauge, the second of a series of industrial measuring and control instruments currently under development using radioactive isotopes. These gauges represent one of the first major industrial uses of Oak Ridge produced isotopes.

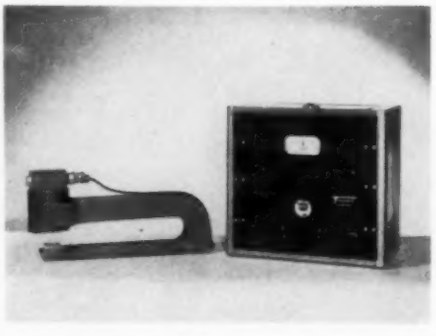
The essential components of the gauge are a source of beta radiation from Strontium-90 and a radiation detector. The sheet material to be measured is interposed between the source and the detector and a part of the radiation is absorbed by the sheet material in proportion to its weight per unit area.

One of the most outstanding advantages of these gauges is the fact that no physical contact is made with the material being measured, causing no marking of delicate or easily marred surfaces as is the case with mechanical and other gauges.

For all practical purposes the chemical composition of the sheet being measured does not affect the calibration of the instrument. The Tracerlab beta gauge is comparable to a chemical balance in that it will provide the same information as is obtained by weighing on a balance a known area of the sheet material in question. Moisture, clay, chemicals, etc., affect results only in proportion to their weight in the sheet.

This instrument is designed for

No physical contact is made with material being measured.



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MINIMIZE EMBRITTLEMENT

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PICKLING ACID INHIBITORS

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A grade of "Rodine" is available to more completely prevent embrittling wire and other products in pickling. It does the same thorough inhibiting job so long and so generally associated with "Rodine" and efficient pickling.

Now, more than ever, it is cheaper to pickle with than without "Rodine".

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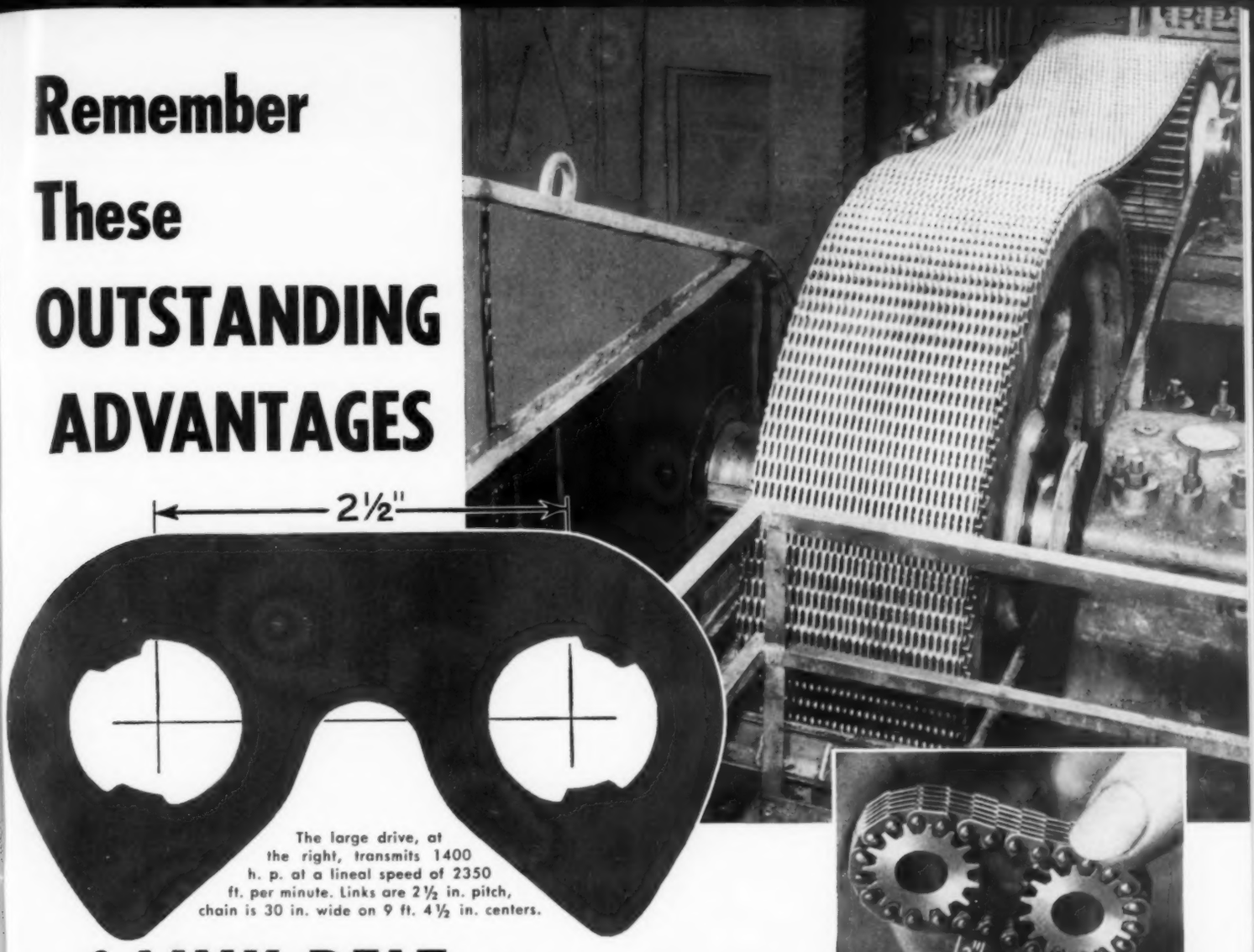


The large drive, at the right, transmits 1400 h. p. at a lineal speed of 2350 ft. per minute. Links are 2½ in. pitch, chain is 30 in. wide on 9 ft. 4½ in. centers.

of LINK-BELT *Silverstreak* SILENT CHAIN DRIVES

Full production at rated capacity results from eliminating slip in power transmission. With Link-Belt Silverstreak silent chain drives, slip is impossible. Every revolution of the motor is transmitted to the driven machine. Losses due to slippage are eliminated and output is increased. Yet Link-Belt Silverstreak silent chain possesses sufficient flexibility to absorb shock. Even on short centers, it runs slack which minimizes friction and wear. Moisture, temperature, age or periods of idleness have no effect on these all-steel precision-built drives. For utmost efficiency and economy, choose Link-Belt Silverstreak silent chain drives.

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Houston 3, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices, Factory Branch Stores and Distributors in Principal Cities.

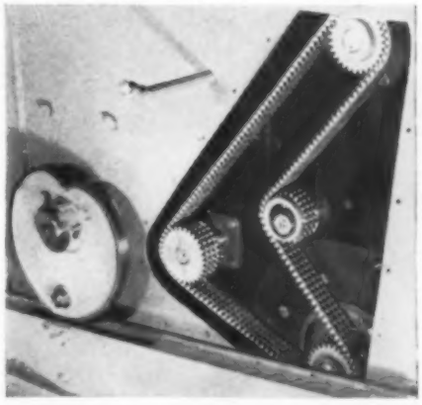
11,554

LINK-BELT

Power Transmission Machinery

"THE COMPLETE LINE"

Smallest Link-Belt Silverstreak silent chain is 3/16 inch pitch. It has been developed for positive, flexible, quiet, high-speed power transmission at fractional h.p.



Duplex type can be flexed to run on either side for reverse rotation of any shaft.

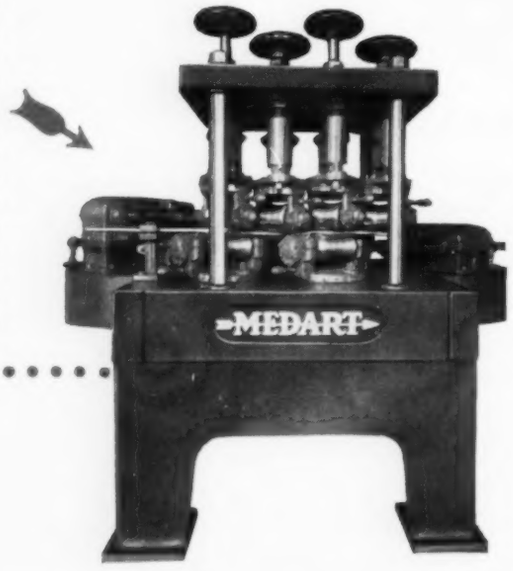
• • •

Link-Belt Industrial Standard Silent chain drives, chain and sprockets, ½ to 50 h.p. are available from stock at Link-Belt Distributors or Factory Branch Stores in all principal cities. Easy selection tables given in Book 2125-A. Ask for your copy today.

MEDART MICRO-MULTICYCLE!

straightening machine designed exclusively for ⅛" to ½" bars and tubing.

Small, compact yet built on the same principle and embodying the same advantages as the Medart 6-in-1 Multicycle Straightener . . . positive, synchronized feed . . . one feeding level . . . two bending cycles . . . single motor . . . and the Medart Micro-multicycle has this PLUS FEATURE: all six rolls are driven! A variable feed-speed range is built into the machine. 3 H. P. motor mounted on base of machine.



MANUFACTURING ENGINEERS OF COMPLETE TRANSMISSION EQUIPMENT AND SPECIALIZED MACHINERY

MEDART

THE MEDART COMPANY - 3500 DE KALB ST. ST. LOUIS, MO.

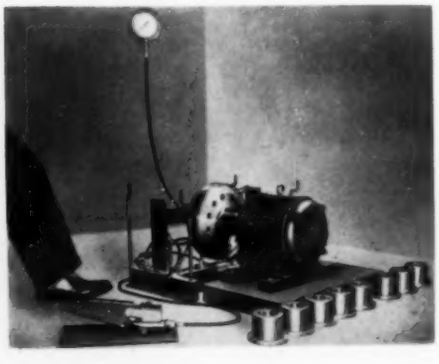
use in small production lines where initial cost must be kept to a minimum and in processes where manual standardization can be carried out without seriously interfering with production. The standardizing procedure with this model requires that the moving sheet material be broken about once every 8 hours while the instrument is balanced to compensate for various factors which may have caused it to drift. It will measure the weight per unit area of continuously moving sheets of material up to 700 mg/cm^2 and provide an indication when manufacturing tolerances are exceeded. The weight (or thickness, if specific gravity is known) information appears on an illuminated 6 in. panel meter. Provisions are made for the use of a repeating meter as auxiliary equipment.

Adjustable indicators are provided on the Sensitrol meter mounted on the front panel so that the operator can set his manufacturing tolerances as a function of the Sensitrol scale. Positive or negative tolerances can be set and, when these are exceeded, a flashing red light (positive) or a flashing green light (negative) appears. Simultaneously, 115 volts a-c appears on one set of enclosed terminals on the back of the instrument if positive tolerance is exceeded, and on another set of enclosed terminals if negative tolerance is exceeded. The user can therefore wire in auxiliary warning or control equipment.

DYNAMOMETERS FOR MOTOR LOAD TESTING

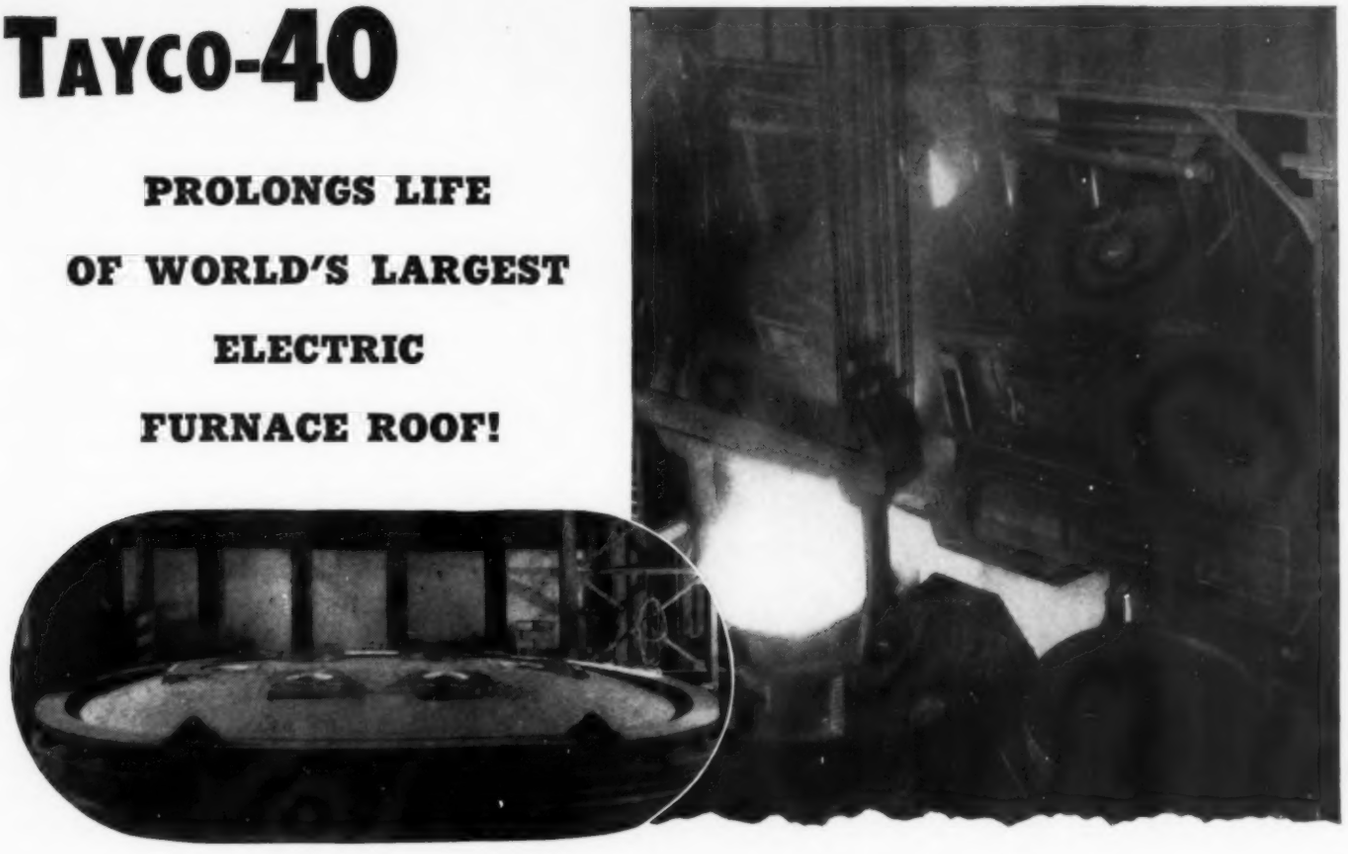
▲ In addition to the SA-483 dynamometer for load testing motors with shaft diameters up to and in-

This model is placed directly on the floor and is provided with jacks for raising it to the motor to be tested.



TAYCO-40

PROLONGS LIFE OF WORLD'S LARGEST ELECTRIC FURNACE ROOF!



100 ton direct arc furnace roof bonded with easy-to-use Tayco-40 Silica Cement. Alloy steel being melted.

The mill which produces alloy steel in the world's largest direct arc electric melting furnace, basic practice, is using Tayco-40 silica cement to prolong roof life. Formerly, silica bricks and shapes were laid dry and then grouted with ordinary silica mortar.

The Melt Shop Superintendent and Masonry Foreman report the following about easy-to-use Tayco-40:

- **The smooth trowelling properties of Tayco-40 make it easier to fit silica bricks or shapes in place with thin, well-filled joints.**
- **Eliminates the necessity of precision cutting on the job.**
- **Prevents silica bricks and shapes from slipping or falling out of the roof when in service.**
- **Tayco-40 will hold spalled or broken ends of brick in place. (Tayco-40 contains no sodium-silicate, is not air-setting and ceramic bond does not begin to form below 1800° F.)**
- **Definite improvement in roof life; roofs withstand rougher handling.**

FOR THE OPEN HEARTH . . . The majority of steel mills in the United States are using Tayco-40 to improve the life of silica open-hearth furnace roofs. Practical experience has proved that roofs bonded with Tayco-40 last longer and can be patched more effectively than those which are laid dry and then grouted with a watery slurry of "silica clay" or mortar.

TAYCO-40 is especially recommended for bonding super-duty silica bricks and shapes, since it is essentially a high silica cement, containing less than 0.50% of alumina. The softening point of Tayco-40 is nearly as high as that of the best grades of silica or super-duty silica brick.

Complete description of properties and other interesting data are given in Bulletin No. 507. We shall be glad to send you as many copies as you need.

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cluding one inch, which was announced recently, Wagner Electric Corp. builds hydraulic dynamometer SA-484 of 30 to 300 ft lb capacity for load testing large electric motors. This model is placed directly on the test floor, and is provided with jacks screws for raising it to the correct height for connection to the motor to be tested, which is secured to a bedplate, subbase or rails.

Adapters for 1⅛, 1¼, 1⅝, 1⅞, 2⅛, 2⅜, 2⅝ and 2⅞ in. motor shafts are furnished with the dynamometer. The 0 to 300 ft lb laboratory test gage and the foot control cylinder for operating the dynamometer can be placed in the most convenient positions.

Tests that can be made with the dynamometer include idle, pull-in, pull-up, full-load and locked. The locked test can be made without having to shut off the motor to insert a locking pin or similar device. The dynamometer can NOT be used to make a heat run on a motor.

Wagner dynamometers are built to order only, and can be delivered approximately 60 days after receipt of order.

Further information is available on Wagner hydraulic dynamometer assemblies SA-483, 0 to 30 ft lb capacity, SA-484, 30 to 300 ft lb capacity, and SA-485, which is a combination of the preceding two models.

PIPE TESTING MACHINES ARE SEMI-AUTOMATIC

▲ A large program of most up-to-date hydrostatic tube and pipe testing installations is being carried out by the hydraulic division of Hydropress, Inc. Several of the thirteen installations which comprise orders from The Kaiser Steel Corp., National Tube Co., Page-Hersey Tubes, Ltd., Republic Steel Corp., Wheeling Steel Corp., Armco, International Corp., and some orders from abroad, have already been delivered. The Kaiser order which will supplement the new pipe mill consists of a shearing and leveling line for pipe skelp, a large tube testing plant and two oil-hydraulic presses for deformative testing of pipes. All of the tube testing machines are designed for semi-automatic, one-man high production operation. According to the specific customer requirements, they are of the one-head, multi-head or rotary-type, respectively. The specifications for testing of welded and seamless pipe range as high as 10,000 psi.

COMPOUND PREPARES METAL FOR PAINTING

▲ Oakite Products, Inc., New York, have announced the development of a new, acid-type cleaning and surface-conditioning material, Oakite Compound No. 33, designed to remove rust, oxides, grease, oils and shop soils from metal surfaces, and to prepare ferrous metals and aluminum for sure-grip adhesion of paint, lacquer and enamel finishes.

The new compound possesses notable detergent and solvent properties, and may be used for prepaint cleaning of large steel or aluminum parts or sheets by wipe-on-method. Dilute solutions are applied at room temperature by brush or cloth, al-

THE ANSWER IS ALWAYS THE SAME

Cleaning and Servicing of present pipe lines is more economical than replacement operations

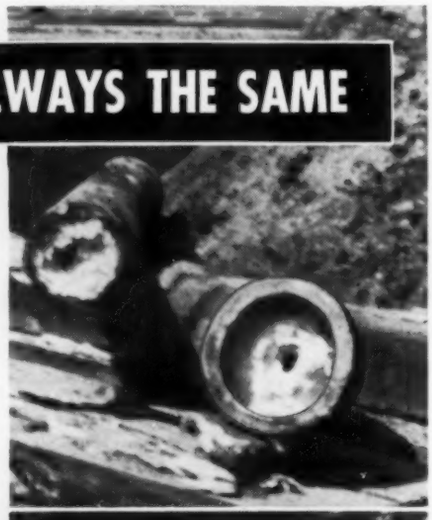

Photo A — Section of 4,645' line of 8" steel pipe before cleaning by rotary method.

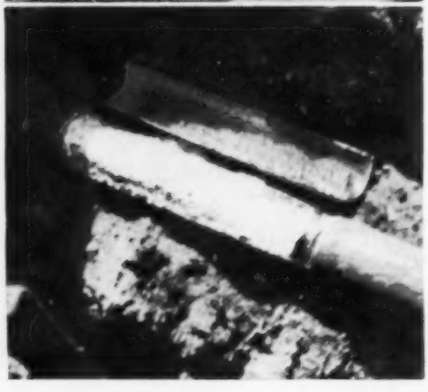

Photo B — Section of 1,020' line of 14" cast iron pipe before cleaning. Note that pipe is completely clogged.

Photos above illustrate pipe line conditions encountered by the Pittsburgh Pipe Cleaner Company in one cleaning operation for a midwest industrial firm.

Note that pipe in photo A is almost completely plugged, while photo B pictures a pipe line that had been sealed with incrustations.

Successful cleaning of these long runs of pipe line again point to the fact that even in cleaning operations as extreme as those shown above, new construction and replacement costs continue higher in comparison with cleaning and servicing existing pipe line systems.

Before considering replacement operations, let us give you the facts and figures about the economy of cleaning as applied to your particular problems.

CONTACT YOUR PITTSBURGH PIPE CLEANER COMPANY ENGINEER TODAY!

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133 Dahlem St., Pittsburgh 6, Pa.
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FOR THE FERROUS AND NON-FERROUS INDUSTRIES
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ROTARY SIDE TRIMMING SHEAR ½" X 108", WITH KNIVES ADJUSTABLE IN 3 PLANES: HORIZONTALLY, VERTICALLY, AXIALLY, AND EQUIPPED WITH SCRAP CUTTERS.
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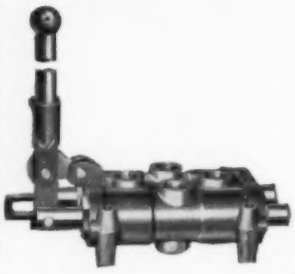
Service built in beneath the surface

● It isn't what you see—but the working parts you can't see that's important about control valves.

Positive and fast acting with U-shaped packers that are expanded by the pressure, Quick-As-Wink Control Valves seal tightly preventing leakage and bleeding. All operating parts are in pressure balance eliminating any tendency to creep or crawl. There is no lapping—no grinding—no metal to metal seating. Every valve is a high quality control—precision made—and individually tested before being shipped. This assures users a maximum of long, efficient, trouble-free service.

Furnished in hand, foot, pilot, solenoid and diaphragm operated designs for controlling all types of air and hydraulic equipment. Let us work with you on your requirements!



Quick-As-Wink Lever Operated Hydraulic Valves

The MF-651-N4 pictured above is a four-way neutral position valve, for controlling double acting cylinders. It can also be furnished with three position "compound-exhaust", or "compound-on" actions. Recommended for use with oil or water up to 150° F. and 2000 PSI. Other types for pressures up to 5000 PSI, —but send for a catalog today and get *full* details about the *complete* line.

Quick-As-Wink Control Valves

THE HIGHER THE PRESSURE THE TIGHTER THE SEAL

Manufactured by **C. B. HUNT & SON, Inc.,** *Salem, Ohio.*

Engineering and Sales Representatives in the Principal Cities

lowed to soak on surfaces briefly, then followed by rinsing and hand-wiping to complete the operation. For washing medium-size or small parts, the new compound solutions may be employed in tanks or in acid-resistant washing machines at working temperatures approximately 140 F. Water rinsing and quick drying complete the cleaning-conditioning cycle. Where light rust is the principal soil on steel parts being processed, the use of the compound may effect considerable time and cost-savings by eliminating the need for separate pickling and rinsing operations.

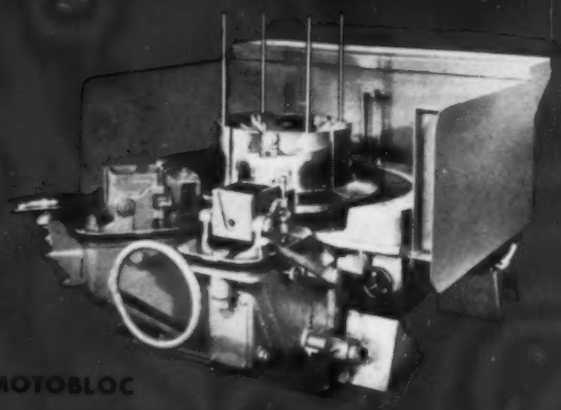
LEAK DETECTOR USED ON PRODUCTION LINE

▲ All fuel and traction tanks produced by the Lintern Corp. are now being tested with a General Electric Type H leak detector.

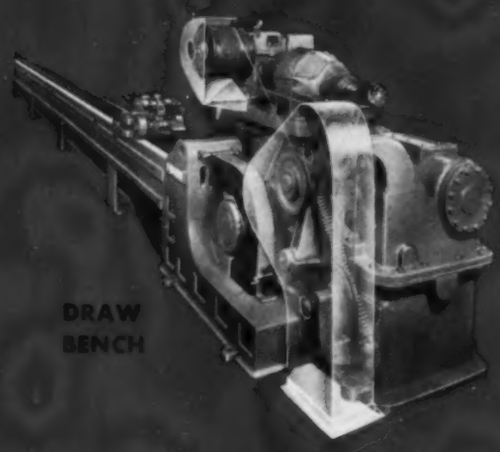
The completely welded fuel tanks are made for use in large transportation trucks and have capacities ranging from 85 to 150 gal. To make certain there are no possible places for gasoline to seep out, all welds are checked by the portable G-E detector before the finished tanks pass from the assembly line.

According to Lintern engineers, six welders and one inspector armed with the leak detector can turn out about 18 tanks in the average day. Fabrication is in six stages. The tanks are placed on iron rails rather than positioners so that they can be

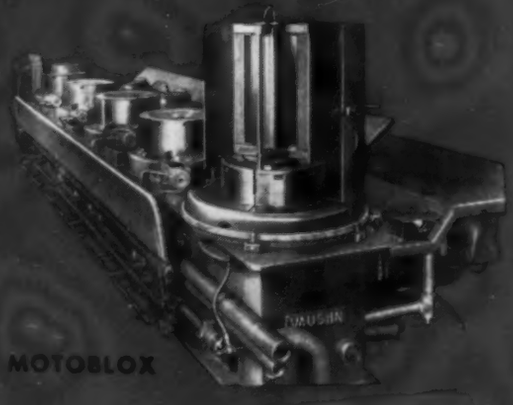
The inspector checks all welded seams with the leak detector.



MOTOBLOC



DRAW BENCH



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speed

precision

versatility

for every Cold Drawing Application

In the cold reduction of wire, tubes, bars and special shapes, Vaughn Machinery offers every modern production advantage . . . every refinement for simpler, faster, more profitable operation. Let us consult on your schedules!

Vaughn

COLD DRAWING MACHINERY

RINGBLOX

"Quick on the Draw!"
VAUGHN MACHINERY
PROFITABLY USED BY LEADING WIRE MILLS SINCE 1899

THE VAUGHN MACHINERY CO.
CUYAHOGA FALLS, OHIO, U. S. A.

COMPLETE COLD DRAWING EQUIPMENT . . . Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

pushed from one welding booth to another as they move along the assembly line. The top plates of the tanks are made of mild steel deck plate; the bottoms and ends are 12 gage sheet steel. First the inner baffles and braces and the bottom sections are tacked together, the side panels are then tacked on, and final weldments are made after all the parts are assembled. The weldments measure about $\frac{3}{8}$ in. Sixty feet of welding electrode goes into each tank.

When the finished tanks reach the end of the assembly line, the inspector checks all welded seams with the Type H leak detector. This electronic instrument is so sensitive that it can detect leaks small enough to release only one ounce of gas a century. Previous leak testing methods were unsatisfactory, Lintern engineers said, because they uncovered only the large leaks. The new instrument enables the company to detect the smallest of leaks in a tank and these can be repaired before the unit is shipped, they said.

HAYS
CAN SHOW
YOU
HOW...
HAYS
INSTRUMENTS AND
CONTROLLERS FOR
HEAT TREATING FURNACES
Indicating • Recording • Controlling
INSTRUMENTS
AND
CONTROLS
FOR EVERY
NEED
TO IMPROVE
PRACTICALLY ANY
PHASE OF STEEL
PROCESSING, TO CUT
FUEL AND LABOR COSTS
The bulletin illustrated is not just a piece of sales literature but a complete 24 page treatise on the instrumentation and automatic control of steel making and heat treating furnaces. You'll want a copy for your reference files, want to profit from its practical, authoritative information.
And remember as you read it, Hays engineers are thoroughly qualified and ready to work hand-in-hand with you in solving your own specific instrumentation and control problems . . . without obligation.
Write for your copy today . . . Ask for Bulletin No. 48-750 (covering heat-treating furnaces). Companion edition covering open-hearth furnaces will also be included.
Steel that's better, with more uniform grain structure . . . maximum production because of continuous equipment performance . . . fewer rejects . . . lower fuel, maintenance and labor costs—these are advantages you can count on when you use Hays instruments and controls for:
Annealing
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Inquiries invited on any of these specific applications.
The HAYS CORPORATION
Since 1901
COMBUSTION & INDUSTRIAL INSTRUMENTS & CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

HAND SAW HAS MANY MAINTENANCE USES

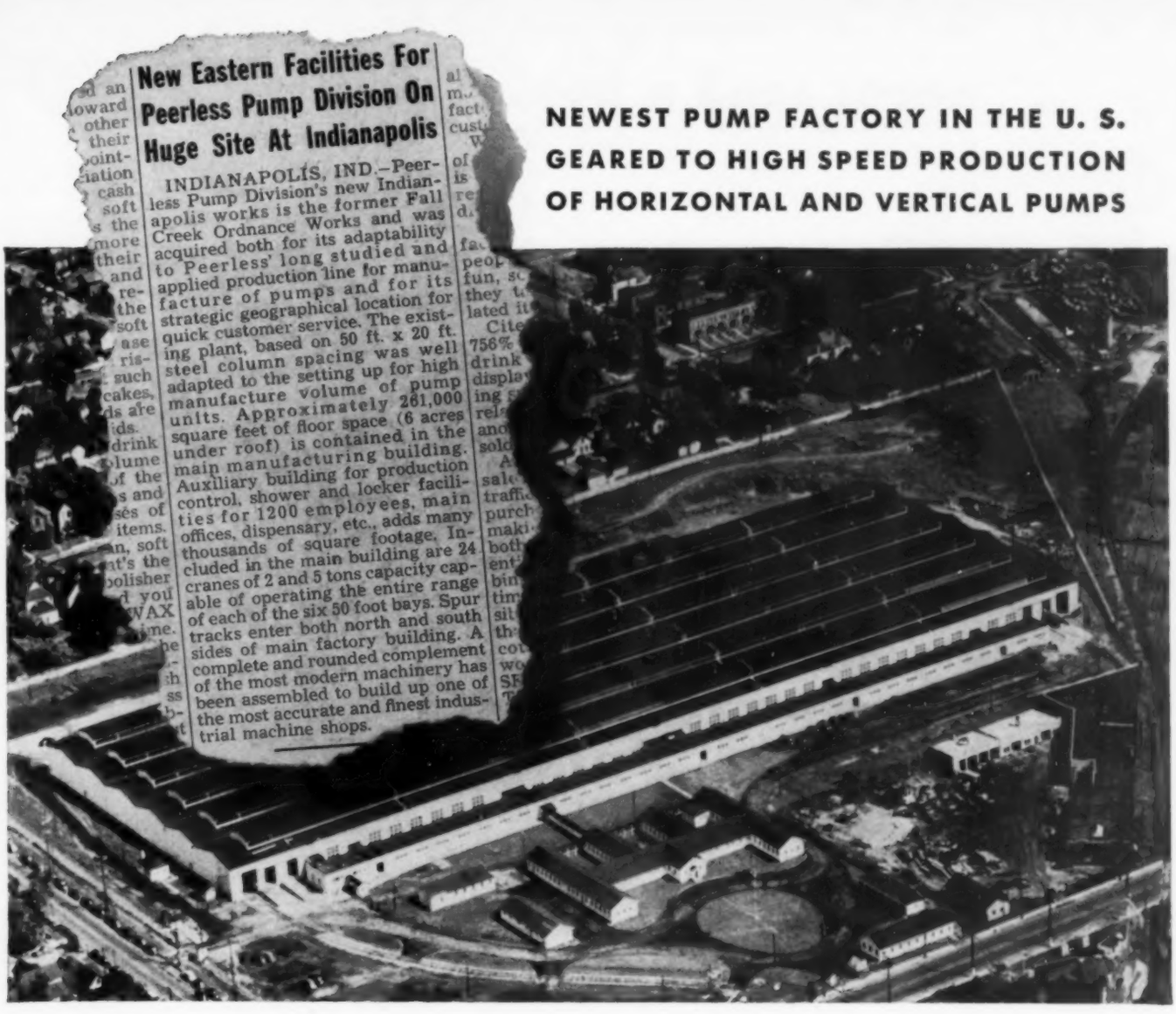
▲ "Maxaw," a new 6 in. lightweight electric hand saw, is now being manufactured by Fred W. Wappat, Inc. The manufacturer points out that the "Maxaw" has "big saw features found on no other lightweight 6 in. electric hand saw. It has a $6\frac{3}{8}$ in. blade that cuts to a full 2 in. depth on square cuts, and cuts 2 in. dressed lumber at a 45 degree angle. The saw easily and accurately makes all jack-rafter cuts on light building

jobs. Depth adjustment, built-in as an integral part of the saw, is from $\frac{3}{16}$ in. to 2 in. Bevel adjustment, also an integral part of the saw, is from 0 to 45 degrees. Trigger-type switch may be locked on when necessary. Saw works perfectly in any position — whether trimming wall sheathing, or hung inverted for ripping operations, or table saw work. Fitted with suitable blades, the saw cuts transite, marble, brick, concrete, tile, and many other tough, hard building materials. The new unit, carefully balanced for effortless one-hand operation, weighs 10 lb net, has the Wappat telescoping guard, and a rigid, sturdy rip fence.

SPEED CONTROL UNIT LENGTHENS BELT LIFE

▲ Reeves Pulley Co. has recently redesigned its newest variable speed control unit, the "Vari-Speed Jr.," to provide longer belt life and improved lubrication. Offered as a means of providing accurate and dependable variable speed control for small and light machinery, such as grinders, buffers, saws, blowers, ovens, etc.,

NEWEST PUMP FACTORY IN THE U. S. GEARED TO HIGH SPEED PRODUCTION OF HORIZONTAL AND VERTICAL PUMPS



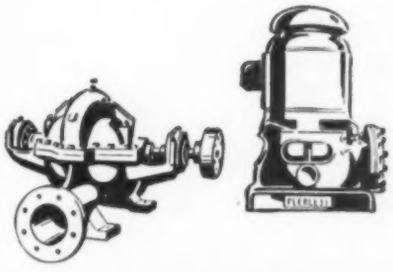
New Eastern Facilities For Peerless Pump Division On Huge Site At Indianapolis

INDIANAPOLIS, IND.—Peerless Pump Division's new Indianapolis works is the former Fall Creek Ordnance Works and was acquired both for its adaptability to Peerless' long studied and applied production line for manufacture of pumps and for its strategic geographical location for quick customer service. The existing plant, based on 50 ft. x 20 ft. steel column spacing was well adapted to the setting up for high manufacture volume of pump units. Approximately 261,000 square feet of floor space (6 acres under roof) is contained in the main manufacturing building. Auxiliary building for production control, shower and locker facilities for 1200 employees, main offices, dispensary, etc., adds many thousands of square footage. Included in the main building are 24 cranes of 2 and 5 tons capacity capable of operating the entire range of each of the six 50 foot bays. Spur tracks enter both north and south sides of main factory building. A complete and rounded complement of the most modern machinery has been assembled to build up one of the most accurate and finest industrial machine shops.

Peerless Pump plant at Indianapolis, Indiana

19 ACRES OF MODERN PLANT FACILITIES DEVOTED EXCLUSIVELY TO MAKING PUMPS

Here is one of America's most modern pump factories. Peerless Pump's new plant at Indianapolis is devoted entirely to making pumps and handling pump service. All types of pumps in the Peerless line, horizontal centrifugal, deep well and close-coupled turbines, Underwriters' approved fire pumps and domestic water systems are made and serviced in this plant. No expense has been spared in tooling Peerless-Indianapolis to insure accurate pump production; testing facilities at Indianapolis are being incorporated into one of the largest pump laboratories in the country. Add these factors to sound basic Peerless pump designs, to the high caliber of Peerless personnel and to Peerless extensive manufacturing facilities at Los Angeles, California, and they combine to make available as comprehensive pump service as is offered to pump owners and buyers anywhere. Peerless-Indianapolis is open for your inspection. You are cordially invited to see for yourself how Peerless-Indianapolis will exactly fit your needs for pumps and pump service. Plan with Peerless; there are horizontal and vertical types for most services, in all industries. Descriptive Bulletins are available on all types upon request.

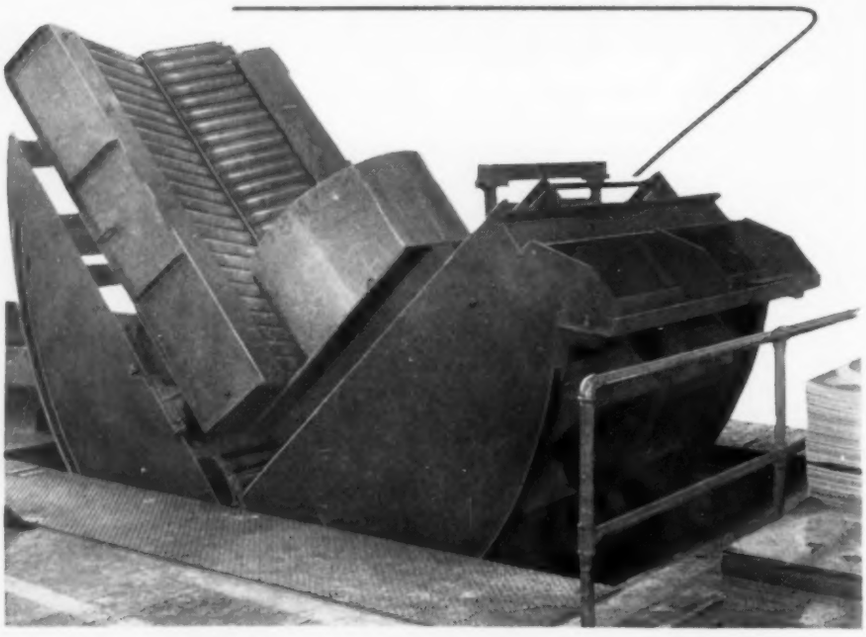


Peerless
VERTICAL AND HORIZONTAL
Pumps

fmc
PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Los Angeles 31, California Indianapolis, Indiana
District Offices: New York 5, 37 Wall Street; Chicago 40, 4554 North Broadway; *Atlanta Office:* Rutland Bldg., Decatur, Georgia; Omaha, Nebr., 4330 Leavenworth Street; Dallas 1, Texas; Fresno, California; Los Angeles 31, California

" never send a boy...



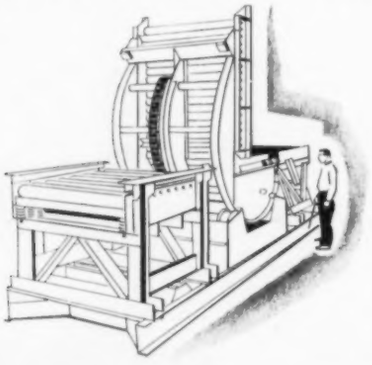
. . . to do a man-sized job"

. . . and coil handling today is certainly just that.

Mathews' Engineers were developing Gravity and Power Conveyers and special conveying machinery for the Steel Industry way back when an 8,000 lb. coil was called **heavy.** As these weights have increased over the years, the Industry has demanded heavier, more rugged conveyer units—conveyers which can stand the terrific beating of continuous steel mill service.

Today, Mathews coil-handling conveyers and special coil manipulating machinery are handling coils weighing as much as 50,000 lbs.

Give your heavy handling problem to Mathews' Engineers and let them go the limit in building into the equipment the weight the job demands. They make available to you the benefit of many years of experience in applying conveyers in heavy industry.



Heavy-duty, spring-mounted coil upenders and side-tilters, typical examples of Mathews engineered machinery for modern steel mill service.

MATHEWS CONVEYERS

GENERAL OFFICES . . . . . *Mathews Conveyer Company*
ELLWOOD CITY, PENNSYLVANIA

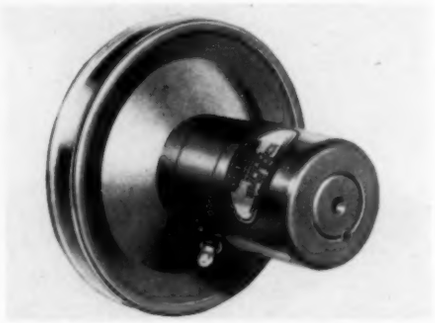
PACIFIC COAST DIVISION . . *Mathews Conveyer Company, West Coast*
SAN CARLOS, CALIFORNIA

CANADIAN DIVISION . . . . . *Mathews Conveyer Company, Ltd.*
PORT HOPE, ONTARIO

Engineering Offices or Sales Agencies in Principal American and Canadian Cities

without stopping the machine, the "Vari-Speed Jr." is a unit assembly comprising a self-adjusting V-type pulley which may be mounted on the shaft of the constant speed motor, and connected with V-belt to driven machine. As the motor is moved back, on a sliding or pivoting base, the V-belt rides on a smaller diameter in the expanding pulley and the speed delivered to the machine is decreased. As the motor is moved forward the pulley contracts under spring tension, the belt rides at a greater diameter and speed is increased.

The unit, which sells for $6.75 up, consists of only four main parts; a



stationary cone-faced disc, sliding cone-faced disc, tension spring and spring cover. The discs are now of pressed steel construction, designed for minimum belt wear, and the bronze bushing which constitutes the entire hub of the sliding disc is semi-permanently lubricated at the factory.

The unit is made in six sizes for use with any standard constant speed motor up to 1½ hp, and any "A" or "B" V-belt. Purchaser can rig up his own sliding or pivoting motor base, or manufacturer will supply sliding base at small additional cost. There is nothing else to buy.

MECHANICAL SEAL FOR CORROSIVE CHEMICALS

▲ Morganite Inc. announces a new self-lubricating mechanical seal capable of withstanding corrosive chemicals. It offers a perfect seal for highly volatile fluids under high pressures. The special seals perform satisfactorily in continuous service at high shaft speeds.

The carbon seals are mechanically strong, immune to most chemical attack, and provide fool-proof sealing free from warping and gumming. En-

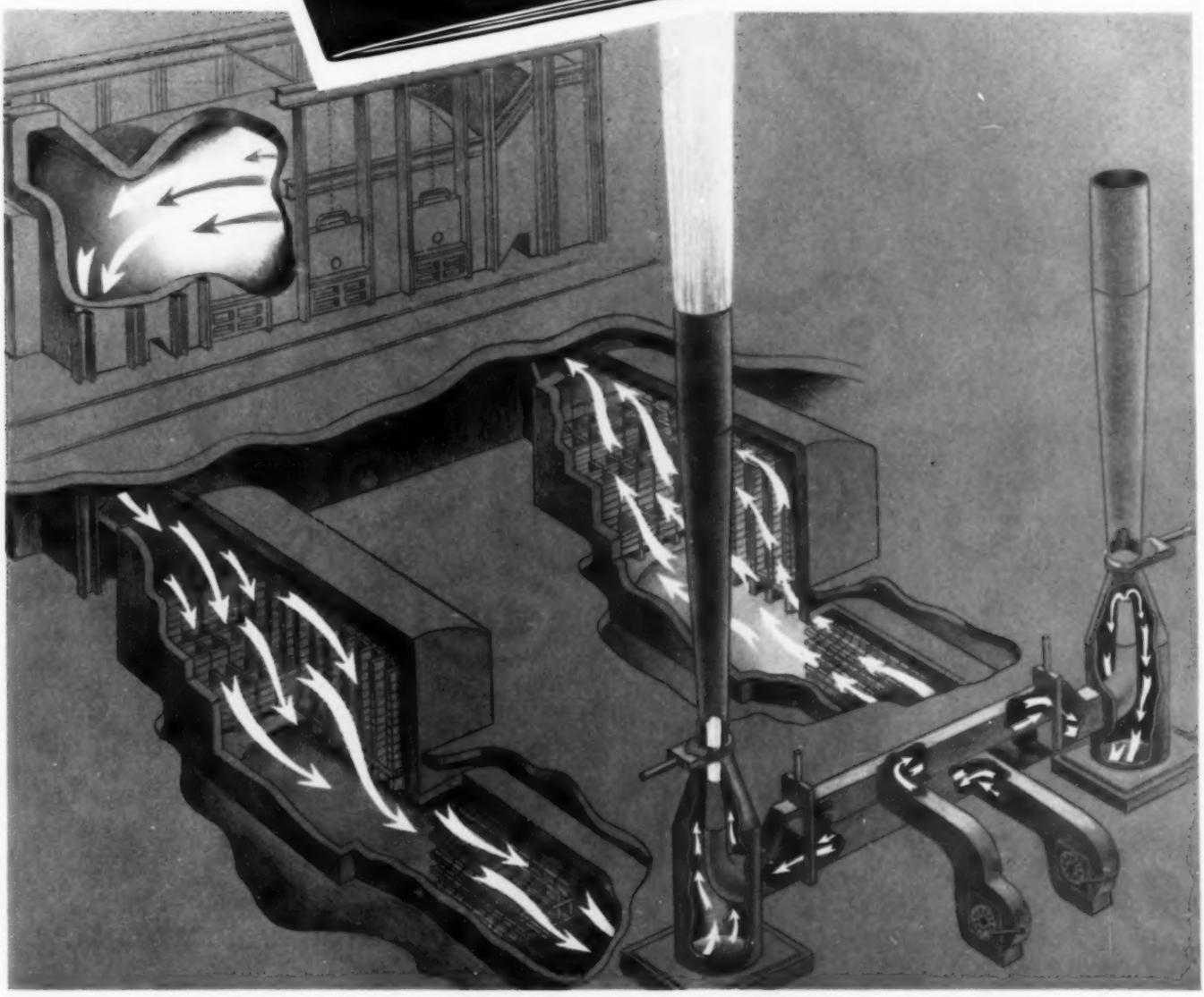
This *New Bulletin* tells you how to get:

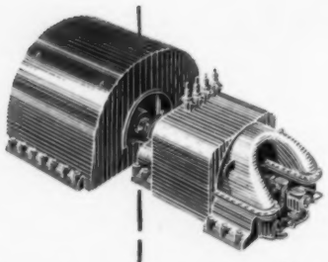
- Faster Heating
- Higher Tonnages
- Better Use of Fuel
- More Output per Man-hour
- Lower Costs

. . . through the Morgan-Isley Furnace Control System. It clearly establishes the superiority of the Morgan-Isley System over natural draft. Send for your copy *today* . . . on your company letterhead, please.

MORGAN CONSTRUCTION CO.
WORCESTER, MASSACHUSETTS

CCC-20





New life expectancy for impeller blades ..with Super-Clean Air!

ABRASIVE dust and dirt entering a high-speed rotary blower are sure death to steel impeller blades. When these blades hit this grit-loaded air, it's like trying to cut through a sandstorm. Rapid wear and erosion result, and you have a replacement problem on your hands.

But there's a sure-fire answer to this problem: AAF Multi-Duty Air Filters. Installed at the blower intake, AAF Multi-Duty filters out abrasive particles—preventing this killing dust and dirt from reaching the rotary blower.

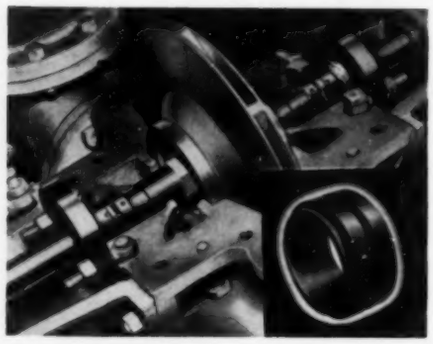
The AAF Multi-Duty is an automatic, self-cleaning air filter. Overlapping panel construction combines self-cleaning and high efficiency air cleaning as integral functions of the operating cycle. Uniformly constant air supply is assured as operating resistance remains fixed when once established for a given dust concentration.

Increase the life expectancy of your impeller blades with AAF Multi-Duty Air Filters—you'll find the cost is only a fraction of the savings. Write for complete information or call your nearest AAF representative.

American Air Filter Company, Inc.
302 Central Ave., Louisville 8, Ky.
In Canada:
Darling Bros. Ltd., Montreal, P. Q.

AAF
AIR FILTERS
AND DUST CONTROL EQUIPMENT

tirely self lubricating, they require no attention for lubrication during the life of the seal. This feature makes Morganite particularly adaptable for installation in inaccessible locations where maintenance and



servicing would be difficult and, in many cases, would require costly down-time of equipment. Lengthy shutdowns due to seal failures are eliminated.

The new self-lubricating carbon seals are recommended for use in pumps, agitators, mixers and similar installations handling corrosive, volatile or otherwise difficult-to-handle liquids.

Self-lapping and self-polishing, Morganite imparts a corrosion resistant coating too, and actually polishes participating surfaces. Pressure seal units of Morganite are available with self adjusting and wear compensating features which, combined with self lubricating properties, reduce servicing and repairs to a minimum.

AUTOMATIC STUD WELDER SPEEDS CONSTRUCTION

▲ An ingenious war-time invention of a shipyard welder that is credited with saving the U. S. Navy millions of manhours in installing insulation and aircraft carrier decks is now helping the construction industry lower its costs. Using a lightweight "gun" that automatically welds fastener studs to steel in a split-second, contractors are supplying corrugated metal and other roofing and siding materials at savings ranging from 26 to 64 per cent.

This was the picture of manpower savings and construction speed drawn from the cost records of contractors who have been using the Nelson automatic stud welding method.

This method was developed by the Nelson Stud Welding Division

It Pays its Way
IN THE WORST PLACES!

Hot steel and the processes required to make it a finished product set up just about the worst assortment of conditions wire and cable have to operate under. That's why you'll find Rockbestos A.V.C. *paying its way* in steel mills, foundries — and also in automotive, ceramic, petroleum and food processing industries and others where severe conditions make it tough for power, control and lighting circuits.

For a few of the reasons why Rockbestos A.V.C. *pays its way* in places where other wires carry a short life, read the panel to the right of the cable. Note that the insulation and braid are made of fibres of asbestos, an ageless, non-deteriorating, heat and flame resisting mineral that won't bake brittle, flow, crack or burn. And remember that it withstands operating temperatures up to 230° F. *continuously* and gives you a *plus* in greater current carrying capacity.

To reduce maintenance expense and protect operations, wire your worst circuits with Rockbestos A.V.C. or All-Asbestos wires and cables — 125 different types in 300 to 5000 volt ratings — single or multi-conductor, braided, lead sheathed or armored. Write for recommendations.

ROCKBESTOS PRODUCTS CORPORATION
New Haven 4, Conn.

ROCKBESTOS A.V.C.
The Wire with Permanent Insulation

HERE'S THE "WHY" BEHIND LONGER SERVICE

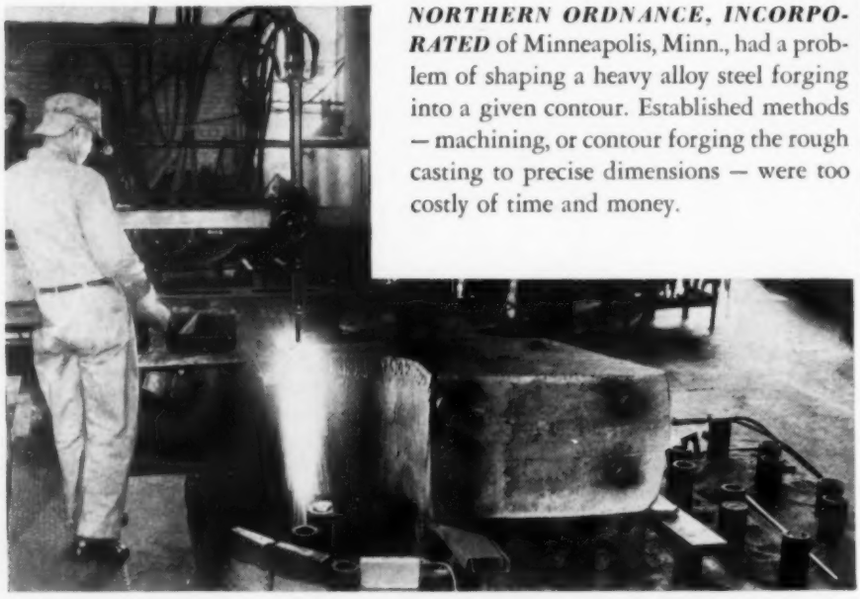
Rockbestos A.V.C. 600 volt Power Cable and similarly insulated Motor Lead Cable (N.E. Code Type AVA) have a maximum operating temperature of 110° C., and this failure-preventing construction:

- Tough, age-resistant, impregnated asbestos braid resists heat, flame, moisture, grease, oil and corrosive fumes.
- Outer wall of heat, flame and moisture resistant impregnated felted asbestos won't dry out, flow, rot or burn.
- Asbestos-protected varnished cambric for high dielectric strength and added moisture resistance.
- Inner wall of impregnated felted asbestos withstands conductor-heating overloads and won't bake brittle or burn.
- Conductor is perfectly and permanently centered in helically applied non-flowing heat, flame and moisture resisting insulation.

One of 125 different constructions designed by Rockbestos for severe operating conditions in ratings up to 5000 volts.

NEW YORK CLEVELAND CHICAGO PITTSBURGH DETROIT ST. LOUIS LOS ANGELES OAKLAND

Shaping heavy forgings faster...at less cost with machine gas cutting



NORTHERN ORDNANCE, INCORPORATED of Minneapolis, Minn., had a problem of shaping a heavy alloy steel forging into a given contour. Established methods — machining, or contour forging the rough casting to precise dimensions — were too costly of time and money.

A. P. Demmer and R. F. Helmkamp, Airco Technical Sales Representatives, recommended oxyacetylene machine cutting the rough forging, using an Airco No. 6A Oxygraph.

Since the forging was about 70" long and 28" thick, weighing almost 7 tons, it was necessary to build special cutting support jigs — one for each cutting requirement. Further, to handle the many cutting positions, the Oxygraph had to be raised 4' off the floor.

The operation was highly successful. The shape cutting technique proved extremely economical and fast, and the company was highly pleased with both the technical aid furnished and the results obtained.

. . . .

TECHNICAL SALES SERVICE — ANOTHER AIRCO PLUS-VALUE FOR CUSTOMERS

To assure its customers of high efficiency in all applications of the oxyacetylene flame or electric arc, Air Reduction has available the broad, practical experience of its nationwide Technical Sales Division personnel. The collective experience and knowledge of these specialists has helped thousands to a more effective use of Airco processes and products. Ask about this Airco "Plus-Value" service today. Write your nearest Airco office. (In Texas: Magnolia Airco Gas Products Company . . . On West Coast: Air Reduction Pacific Company.)

AIRCO **AIR REDUCTION**

Offices in Principal Cities

Headquarters for Oxygen, Acetylene and Other Gases... Calcium Carbide... Gas Cutting Machines... Gas Welding and Cutting Apparatus and Supplies... Arc Welders, Electrodes and Accessories

Construction work is materially faster with this welding gun.

of Morton Gregory Corporation. The lightweight automatic stud welding gun enables a four-man crew, working entirely from the outside, applying non-corrosive fasteners, to turn out an average of 25 per cent more work than an efficient five-man crew working with conventional straps, clips and rivets, for which inside scaffolding is required. In the case of steel roof decks, where a four-man crew is used in both tack welded as well as stud welded jobs, the increased ease of installation enables the men to place 32 squares a day by stud welding instead of 18 by tack welding.

Cost reductions obtainable through stud welding have resulted in its use on housing and commercial, as well as heavy industrial and engineering.

OFFER MAGNETIC ROLLS FOR CONVEYING STEEL

▲ Dings Magnetic Separator Co. is offering magnetic rolls for conveying sheets, plates and bars. These magnetic rolls provide a positive tractive effort so that movement of the product does not depend on friction contact alone. Encased in a thin steel shell welded to the end poles, the rolls are waterproof for protection against moisture present when quenching or acid treatments are used. Coils are wound with glass insulated wire. Rolls available in diameters of 12 in. or more, and in widths in multiples of 6 in.

Publication Service...

SEPTEMBER, 1949

You Can Obtain...

... any of the bulletins reviewed in the Publication Service of the IRON AND STEEL ENGINEER without obligation or cost. Simply circle the desired item numbers on one of the prepaid postal cards and mail. The requests will be forwarded to the manufacturers involved who will send the bulletins to you.

(1) Special Bearings

A bulletin is available on special bearings of unusual design. The bulletin tells how this bearing company specializes in the design and production of unusually large, high precision bearings, in sizes from 4 in. bore to 120 in. outside diameter. The Kaydon Engineering Corp.

(2) Rotating Joints

A folder is available on ball bearing, high temperature rotating joints. These joints are designed and built for operation with hot or cold rolls using steam, hot water, hot oil, cold water, brine and other fluids for constant or intermittent service. Chiksan Co.

(3) Twin Strainers

A bulletin has just been published on the new Elliott twin strainers for continuous service in cleaning liquids. These strainers are used to remove foreign matter from process water, from water or oil used for lubrication, and to remove sediment from water used for cooling purposes. One large steel mill uses over 200 twin strainers in various sizes throughout the plant, protecting every piece of water-using apparatus. The twin strainer has two strainer chambers in one body. By operating two valves, either chamber can be shut off for removing or cleaning its strainer basket. The basket is removed through the door opening, dumped and replaced in a few moments. There is no interruption of flow during cleaning. The booklet tells how these strainers may be installed inside the plant wherever most convenient and accessible. They may be used in either suction or pressure lines in any position. (A-13). Elliott Co

(4) Electrical Cable Vulcanizers

A complete bulletin is available on rubber cable vulcanizers. This bulletin tells how these vulcanizers provide a simple, easy and inexpensive means of replacing insulation on all types of rubber covered flexible cables; making broken or damaged sections good as new. Two styles are available, both electrically heated. One applies heat thermostatically controlled directly to its molds. The other heats its molds by automatically controlled steam pressure. Both models are extremely simple to operate. (RV-106). Mines Equipment Co.

(5) Hydraulic Valves

A very complete catalog on high pressure hydraulic valves is available. These valves can be used to control hydraulic sprays and hydraulic manipulators; to operate mill tables, screwdowns and presses, etc. This catalog is one of the most complete catalogs on hydraulic valves ever available. R. D. Wood Co.

(6) Reclamation and Hardfacing

A bulletin is available describing "Amsco" welding products for reclamation and hardfacing. The material contained in this book defines applications which have been field tested and proved over a period of years. It contains descriptive information of hardfacing and build-up rods and electrodes, and weldments. It tells how these rolled or drawn electrodes are coated by the extrusion process, the coating being concentric with the core and uniform in thickness from end to end. This insures a deposit of uniform chemical analysis, making electrode arc characteristics dependent largely on coating mixture, density, concentricity and proper thickness to core wire, all of which are controlled precisely by the extrusion process. (1047-W). American Manganese Steel Division, American Brake Shoe Co.

(7) Jack Selection Guide

A thorough guide for selecting jacks is available to you. This selection guide was designed for the mining industry but contains many ideas that can be used in shop repair work. If you are interested in seeing the various types of jacks that are available for maintenance work, you should have this catalog. The Duff-Norton Manufacturing Co.

(8) Certified Combustion

A bulletin describing "Certified Combustion" gas burners is available. This bulletin tells how exact air-to-gas ratios can be set by means of a pointer and dial arrangement on the burner. No further manipulating of valves or adjustments is needed. This means positive initial light-up regardless of the number of burners involved. Five different burner arrangements are shown as well as cutaway sketches and dimensions. (58). North American Manufacturing Co.

(9) Pulverizers and Crushers

A catalog is available on swing hammer pulverizers and crushers. It tells how these pulverizers can be used in by-product coke plants and fuel plants for reducing coal samples. There are two types of swing hammer pulverizers and both types are made in a large number of sizes for handling either large or small capacities. This catalog is one of the most complete catalogs on pulverizers and crushers that has been published. (710-A). Jeffrey Manufacturing Co.

(10) Hydraulic Duplicators

A bulletin is available describing the Turchan follower machine which is a hydraulic duplicating attachment that will usually eliminate the need for purchasing additional machine tools when mass production or job lot duplicating is to be done. A master pattern or

template is duplicated directly and automatically in metal. The unit can be easily attached to any standard milling machine, shaper, planer or grinder. Intricate die sinking and irregular contours and profiles which often require special machinery can be produced on your present equipment without the need of specially trained or skilled men. The bulletin shows this duplicator in operation such as turning, milling, planing, profiling, grinding and contour turning. Turchan Follower Machine Co.

(11) Conduit Fittings

A folder is available describing "Pylets." These are heavy duty conduit fittings designed for easier application, greater strength, and maximum security of wiring installations. Various types of these conduit fittings are illustrated. (207). The Pyle-National Co.

(12) High Capacity Switches

A bulletin is available describing disconnecting switches for outdoor service. It tells how these switches are designed to fill the need for heavy ampere capacity equipment which can be depended on to carry full load continuously and withstand short circuits up to their full thermal ratings. Steel mill operating men will appreciate the practical construction of these heavy hook stick operated switches. Contact pressure is maintained without the use of cams, threads or other complicated devices. A slight pull on the hook ring releases the pressure and the switch is fully opened with ease. The closing operation is equally positive and effortless. (4806). Delta-Star Electric Co.

(13) Boiler Water Level Control

A technical bulletin is available describing boiler water level control at the Blackhawk Station of Wisconsin Power and Light Company. A complete description of the equipment contained in this power station is contained in this bulletin. (487). Northern Equipment Co.

(14) Clay Guns

A new catalog section describing a full line of clay guns has just been issued. The new bulletin, which contains 13 pages, places particular emphasis on the recently redesigned and improved Brosius two motor electric mechanical clay gun, and also covers the company's self-contained hydroelectric and steam or air operated guns. Complete information and detail drawings are included. Edgar E. Brosius Co., Inc.

(15) Alloy Chain Bulletin

A new 12-page bulletin is available describing Taylor made alloy steel chain. It contains complete specifications on sizes 1/4 in.—1 3/4 in. diameter inclusive; working load limits, definitions and cautions, recommended use and details of chain service for Taylor alloy steel chains, sling chains and attachments. Each page is well organized to give you quick, easy answers to your questions. S. G. Taylor Chain Co.

(16) New Car Shakeout

A bulletin is available describing a new, lighter-weight Robins car shakeout, Model GS. Completely different in design from the original Model HD car shakeout first presented some 3 1/2 years ago, this new unit is designed to unload up to 15 hopper-bottom cars of granular material in a day while priced for the 2-car-a-day market. (130). Robins Conveyors Division, Hewitt-Robins, Inc.

(17) Large Induction Motors

A special 32-page issue of the E-M synchronizer is available covering in four parts the basic theory, operation, characteristics and applications, and control of large induction motors. Written by G. L. Oscarson, chief application engineer, the booklet presents a comprehensive, practical, fact-filled treatment of squirrel-cage and wound rotor motors. It is lavishly illustrated with photographs and cut-away views and has nearly 50 graphs with explanatory figures accompanying the test. (28). Electric Machinery Manufacturing Co.

(18) Permanent Magnetic Separators

A new 12-page catalog describing the complete line of Eriez permanent non-electric magnetic separators and electronic metal detectors, is now available. Complete specifications regarding weights, sizes and strength comparisons for various chute and spout magnets are given as well as tables of operating capacities for permanent magnetic pulleys, drums, pneumatic line assemblies, pipeline traps, road sweepers, ferrous filters, floor sweepers and pipe rolls. All pieces of equipment are fully illustrated through the use of photographs and engineering drawings. Savings realized through the use of permanent magnets, the importance of application engineering and the essential of good permanent magnets, are fully explained. Also discussed are factory engineering and laboratory services offered by the company. (14). Eriez Manufacturing Co.

(19) Slide Table

In a small pocket size slide table is condensed conversion data for punched screen plate, wedge wire screen and screen wire mesh. Data is correlated for inches, millimeters, U. S. wire mesh and Tyler wire mesh. The readings for these four measures are direct. By means of a slide each measure can be converted to decimal inches and microns. The slide ranges from one inch to 400 mesh. McNally Pittsburg Manufacturing Corp.

(20) Ground Anodes

A new descriptive folder is announced presenting information on "National" ground anodes and backfill material for use in cathodic protection and electrical grounding. Carbon and graphite ground anodes are discussed for such cathodic protection applications as pipe lines, water and gas mains, refinery equipment, underwater structures and structural footings; and as electrical ground connections for installations such as solvent tanks, automatic telephone exchanges, railway signal systems and lighting protection systems. The bulletin describes the sizes and grades of graphite and carbon anodes available, outlines their application, installation and operation, and contains new information on backfill materials. Tables are included for determining the type, size and quantity of ground anodes and the amount of backfill required. Also discussed is the type BF-2 graphite backfill material which performs the functions of

furnishing an increased active surface to act as an anode for current discharge and lowering anode-to-soil resistance, thereby greatly prolonging the life of the anode by transferring electro-chemical attack from the anode to the backfill. (M-8500A). National Carbon Co., Inc.

(21) Alloy Steel

"How to Specify and Buy Alloy Steel with Confidence," is the title of a new 24-page booklet just published. In the foreword, it is pointed out that because alloy steels must be heat treated to attain their full strength, there are a number of control steps which should be taken if alloys are to be purchased and used with complete confidence that they will give the service required. The booklet then covers these control steps one by one, outlining in detail the safest methods of specifying and buying so that the user may be protected against the possibility of, (1) getting the wrong alloy, (2) errors in heat treating, (3) costly breakdowns resulting from using the wrong alloy or failure to properly heat treat the right alloy steel. Also included in the booklet is an explanation of the end-quench hardenability test, data on buying alloy steel on the basis of hardenability, and information on standard and special types of alloy and carbon steels including aircraft quality, free cutting bars and tool steels. Joseph T. Ryerson & Son, Inc.

(22) Air Moving Equipment

To assist the public in the use of terminology and the general functions of various types of fans, the National Association of Fan Manufacturers has published a bulletin illustrating and describing air moving equipment. For easy reference, the material is arranged in tabular form under two general headings for air moving equipment, each illustrating four specific types of fans, followed by a description of functions. It is hoped the information will be helpful in understanding the terms and names used by the industry. (108). National Association of Fan Manufacturers.

(23) Roof Failure Prevention

To help the architect, engineer and contractor prevent roof failures caused by unusual climatic conditions or atmospheric concentrations of smoke, fumes and other corrosives, a new publication has been issued by International Nickel. The bulletin, "Basic Application Data," lists suggested gages for principal exterior building applications of the soft-temper Monel roofing sheet introduced last year. These suggestions are based on the records of existing Monel installations, veterans of 35 to 40 years service in some of the most severe conditions in the country. The excellent corrosion resistance and high mechanical properties of Monel make it possible to employ lighter gages than those commonly used for standard roofing and other sheet metal parts. This new folder also contains information on the availability and relative cost of Monel roofing sheet. Also included are fabricating and installation tips and a specification wording for architects and engineers to use when specifying Monel. (AIA File 12). International Nickel Co.

(24) Synchronous Motors

Operating advantages and construction features of Allis-Chalmers bracket bearing synchronous motors in sizes from 30 to 1000 hp are described in a new 16-page bulletin released. In addition to a complete line of standard, open-type synchronous motors, Allis-Chalmers is equipped to build motors with special features to satisfy virtually any service requirements, the bulletin points out. These include units with grease lubricated anti-friction bearings, enclosed collector assemblies, semi-protected, protected, drip-proof, splash-proof, separately ventilated, and totally-enclosed motors. Motors for belted service, in general, are of the same construction as those for direct connection, although there are rating and speed limitations on their use, the bulletin explains. Shown is a table of the sizes to which bearing pressures limit the application of two bearing motors. Vertical synchronous motors, which are built in all sizes for pump drives and other applications, exciters and starters, are also touched upon in this bulletin. (05B6112A). Allis-Chalmers Mfg. Co.

(25) Oil Burners

A catalog is available describing Hauck Series B low pressure air type oil burners with complete and separate indicator dial control of all atomizing air and oil supply for wider range of firing capacity and better combustion on annealing, forging, heat treating, and metal melting applications. (409). Hauck Mfg. Co.

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ITEM	COMPANY	BULLETIN	DESCRIPTION
50	AMERICAN CHEMICAL PAINT CO.		Data on improving pickling and minimizing embrittlement with "Rodine."
51	AMERICAN MANGANESE STEEL DIVISION, AMERICAN BRAKE SHOE CO.		Reprint describing hard surfacing by fusion welding.
52	ASKANIA REGULATOR CO.	BULLETIN 139	Describes furnace pressure regulators which provide precise, automatic adjustment of a flue, damper or fan speed for maintaining control.
53	AUTOMATIC TRANSPORTATION CO.		Catalog describing Automatic electric trucks for handling steel and allied products.
54	BACHARACH INDUSTRIAL INSTRUMENT CO.	BULLETIN 715	Describes the Tempscribe self-registering recording thermometer.
55	BEDFORD FOUNDRY AND MACHINE CO.		Catalog containing details of cranes having capacities 5 to 150 tons.
56	BLOOM ENGINEERING CO., INC.		Bulletin giving complete details on Bloom baffle-type burners.
57	BROWNING AND CO., INC., VICTOR R.	BULLETIN "S"	Describes Browning mill type cranes.
58	BUFFALO FORGE COMPANY	BULLETIN 3295-A	Describes shear billets with speed, accuracy and economy on Buffalo billet shears.
		BULLETIN 3650	Catalog on mill type shears.
		BULLETIN 360-C	Describes Buffalo combination slitting shears, punches and bar cutters.
59	CLARK CONTROLLER CO.	BULLETIN 106-R	Descriptive bulletin on a-c operated d-c brakes.
60	ELECTRIC CONTROLLER AND MANUFACTURING CO.	BULLETINS 1004 AND 1006	Describes long life brakes for a-c and d-c motors.
61	ELECTRIC SERVICE MANUFACTURING CO.		300-page illustrated catalog giving details on the complete line of Electric Service insulators, collectors, and rail shoes that are available.
62	FARREL-BIRMINGHAM CO., INC.	BULLETIN 115	Describes in detail the many features of the Farrel heavy duty roll grinder.
63	FARVAL CORP.	BULLETIN 25	Full description on Farval centralized systems of lubrication.
64	FLUOR CORP., LTD.		"Colder Water Cheaper," a booklet which describes Fluor counterflo cooling towers.
65	GENERAL ELECTRIC CO.	BULLETIN GEA-4469	Bulletin giving details on how better-cooled, better-protected d-c motors can help cut costs in your mill.
66	HAYS CORP.	BULLETIN 48-750	24-page treatise on the instrumentation and automat c control of steel making and heat treating furnaces.
67	HOMESTEAD VALVE MANUFACTURING CO.	REFERENCE BOOK 38	Complete information on Homestead Cam-Sealed Quarter-Turn valves.
68	HUNT AND SON, INC., C. B.		Catalog giving the full details about the complete line of Quick-As-Wink lever operated hydraulic valves.
69	KOPPERS CO., INC., FAST'S COUPLING DEPT.		Catalog containing all the facts and specifications on Fast's couplings.
70	LEEDS AND NORTHRUP CO.		Catalog giving full details on how L&N helps increase steel production.
71	LINK-BELT CO.	BOOK 2125-A	Complete data and selection tables on Link-Belt Silverstreak silent chain drives.
72	MORGAN CONSTRUCTION CO.		This bulletin describes the Morgan Isley Furnace Control System.
73	MURRAY MANUFACTURING CO., D. J.	CUH-849-ISE	Capacity tables and engineering data on GRID unit heaters.
74	OKONITE CO.	BULLETIN IS-1037	Describes the advantages of Okolite-Okoprene cables.
75	PENNSYLVANIA TRANSFORMER CO.	CATALOG 1049	Describes four new Pennsylvania "Pole Star" transformers which operate with greater efficiency and at less cost.
76	POOLE FOUNDRY AND MACHINE CO.		Catalog giving full description and engineering data sent upon request.
77	REPUBLIC FLOW METERS CO.	BULLETIN 48-2	Describes in detail the Republic pneumatic electric flow metering system.
78	TAYLOR SONS CO., CHARLES	BULLETIN 507	Full description of properties of Tayco-40 silica cement.
79	TAYLOR CHAIN CO., S. G.		Booklet describing Taylor Made Alloy Steel Chain.
80	TIDE WATER ASSOCIATED OIL CO.		"Tide Water Associated Lubricania" gives clear, concise descriptions of the basic tests used to determine important properties of oils and greases.
81	TRABON ENGINEERING CORP.	BULLETIN 484	Complete data on Trabon lubricating systems.
82	WAGNER ELECTRIC CORP.	BULLETIN MU-185	Information on the complete line of Wagner motors.
83	WARE FUSE CORP.		Descriptive circular on Ware "Hi Lag" renewable fuses.
84	WESTINGHOUSE ELECTRIC CORP.	BOOK B-3776	Describes the uses and advantages of "Micarta" roll-neck bearings.
85	WHITCOMB LOCOMOTIVE CO.		Illustrated literature on Whitcomb locomotives.

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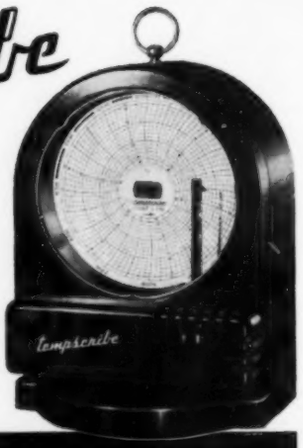

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30° to 60° F	24 Hours
40° to 100° F	7 Days
40° to 100° F	24 Hours
60° to 90° F	24 Hours
60° to 90° F	8 Hours
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YOU will be surprised how much time can be saved in the spotting and switching of cars by using a Jones car puller. These sturdy, compact units will speed up car handling to the point where they soon pay for themselves in the saving of time and labor.

These car pullers are built by Jones as complete units with motor included if desired, or with base to take standard motor, as supplied by the purchaser. The cable drum is driven by a Jones triple reduction Herringbone speed reducer and the control station may be located at a point to give the operator a clear view of the tracks and spotting positions.

Even in plants where comparatively few cars are handled it has been found that a Jones car puller more than pays its way. Prices and complete information will enable you to judge whether such an outfit might pay out in your plant. Write for complete information.

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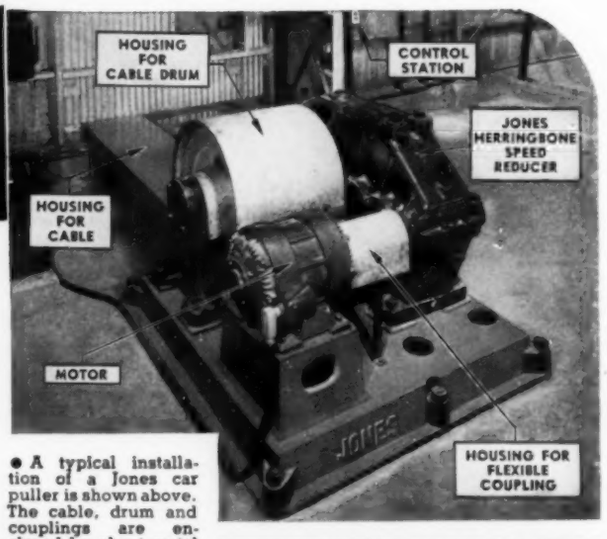

● A typical installation of a Jones car puller is shown above. The cable, drum and couplings are enclosed by sheet metal housings as an extra precaution in this installation to eliminate all hazard from moving parts.

● A complete Jones car puller unit. These outfits are for use with wire rope and are manufactured in a wide range of capacities to suit the number of cars to be handled in each plant.

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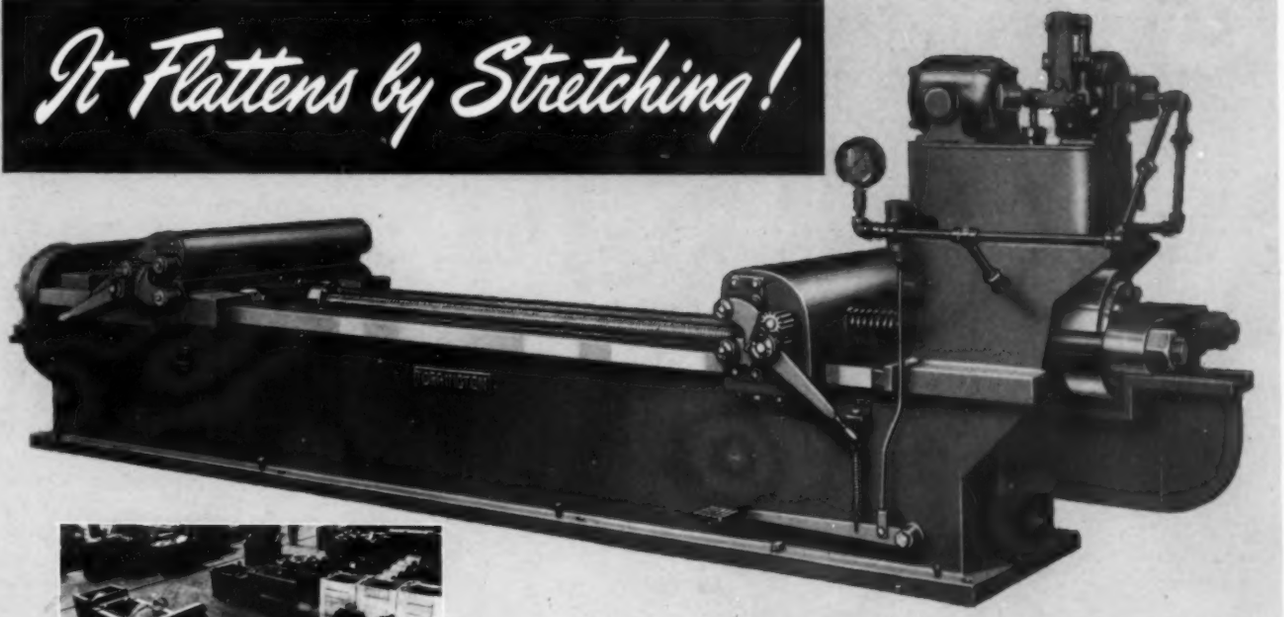

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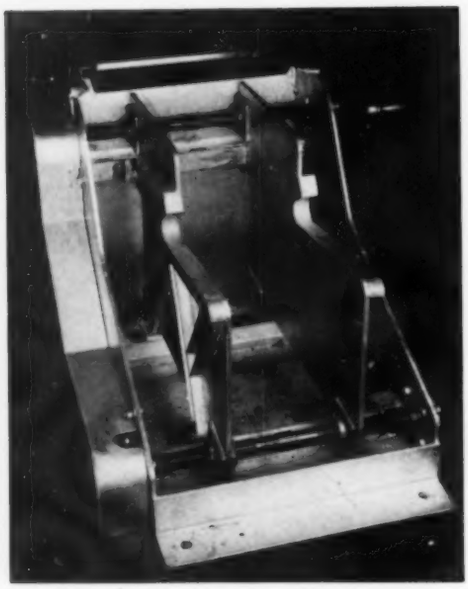

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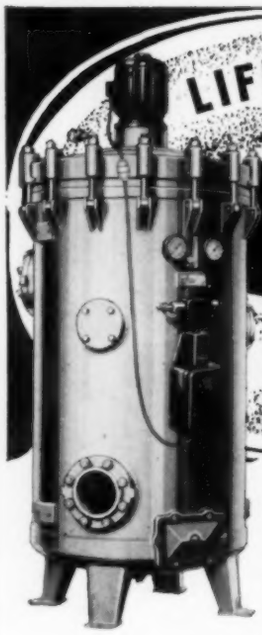

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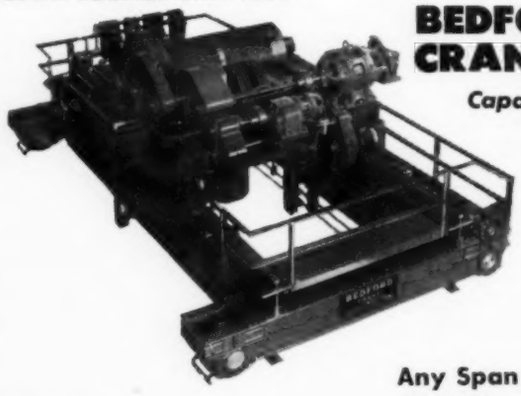

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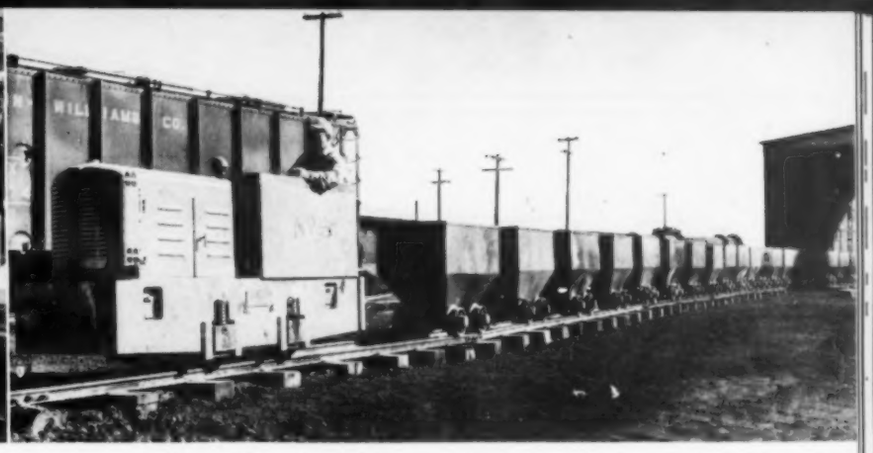
At eastern copper plant an 8-ton Diesel picks up loaded car for delivery to warehouse.



Whitcomb 4-ton Industrial Locomotive hauls metallic concentrates from loadi dock at Ozark Smelting & Mining Company, Coffeyville, Kansas.

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There's no power more economical than Diesel; no locomotive finer than a Whitcomb.

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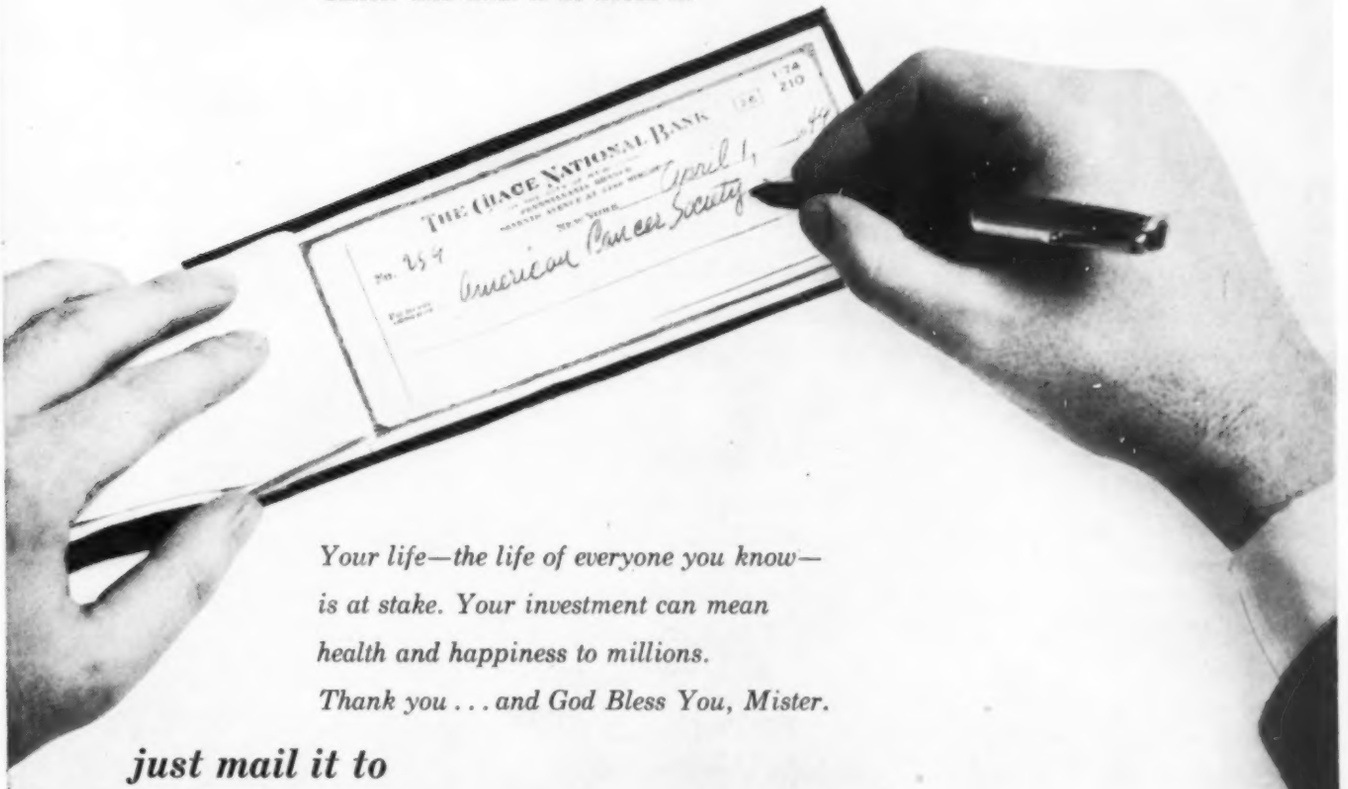

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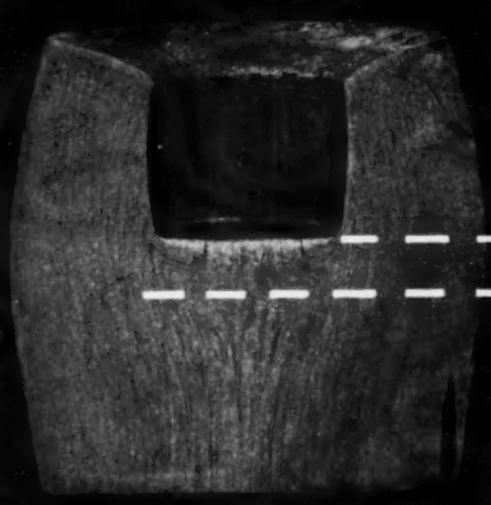

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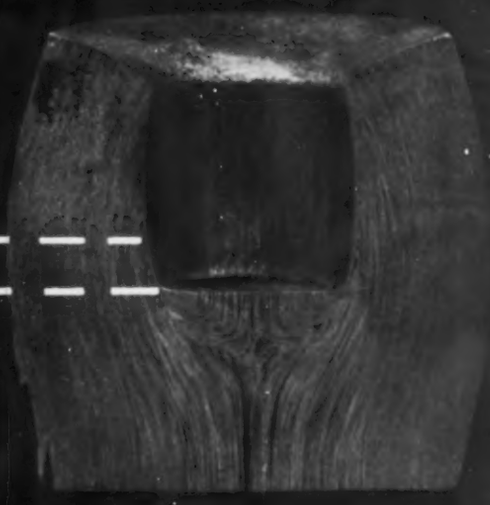

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EQUIPMENT Hydraulic press . . . load, 2,000 psi . . . tungsten-carbide penetrator, flat face

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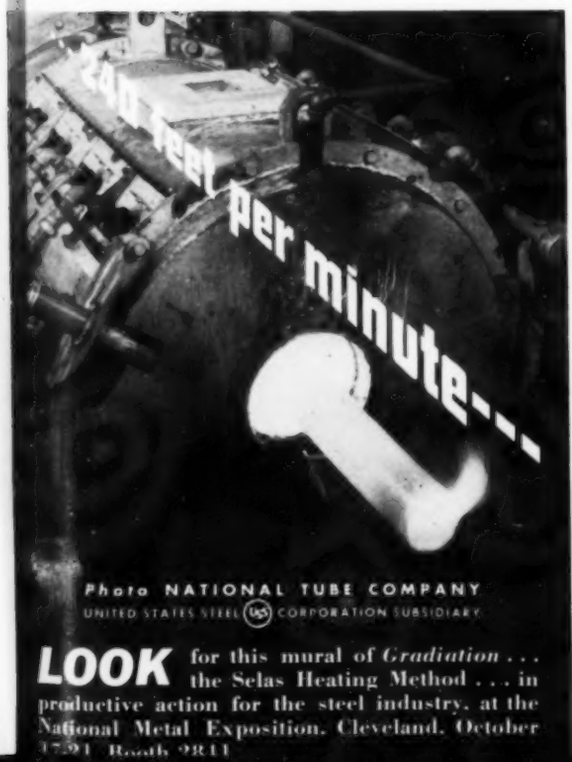
Samples shown here—deep etched . . . photographs, actual size . . . *For more information*—communicate with SELAS.



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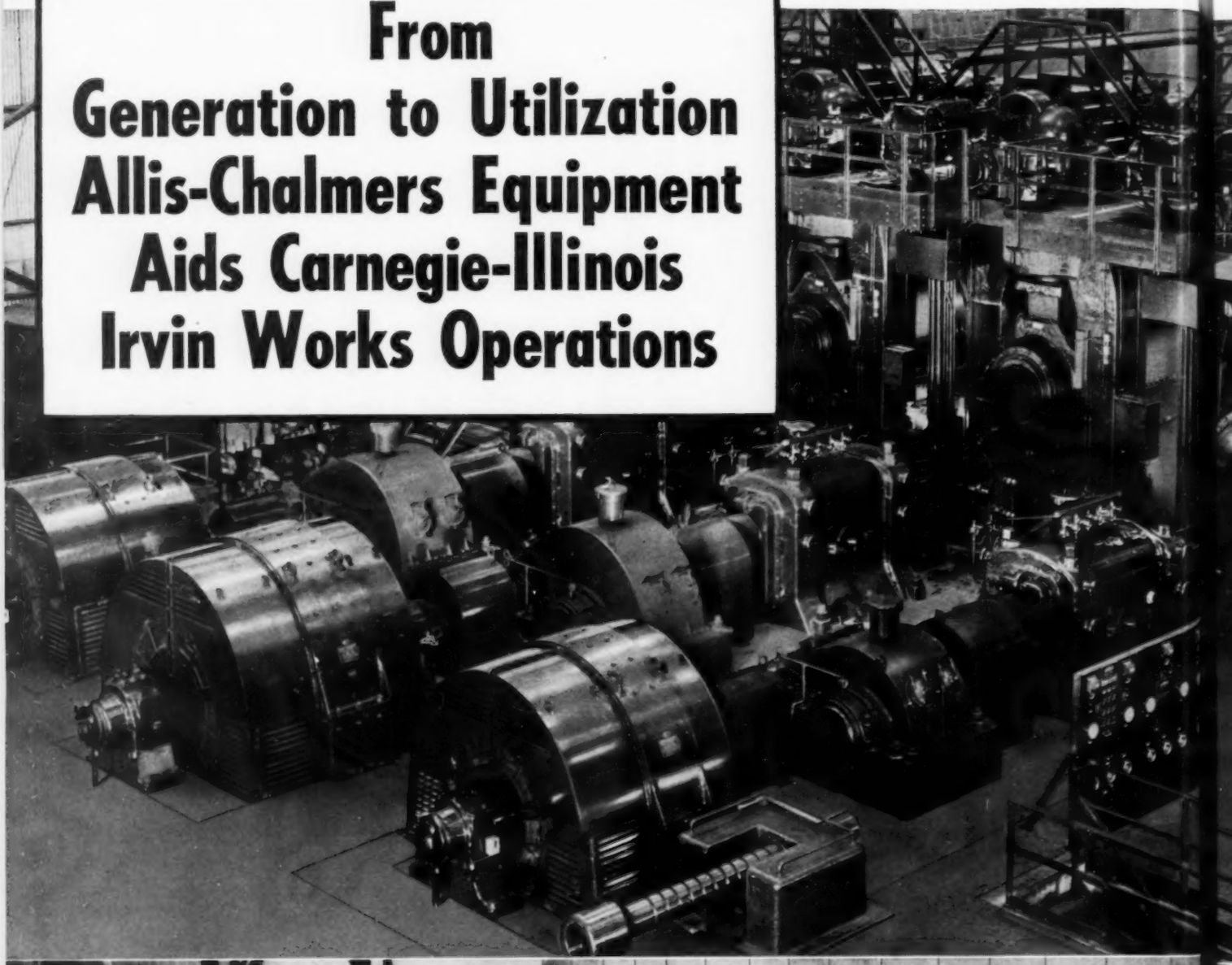
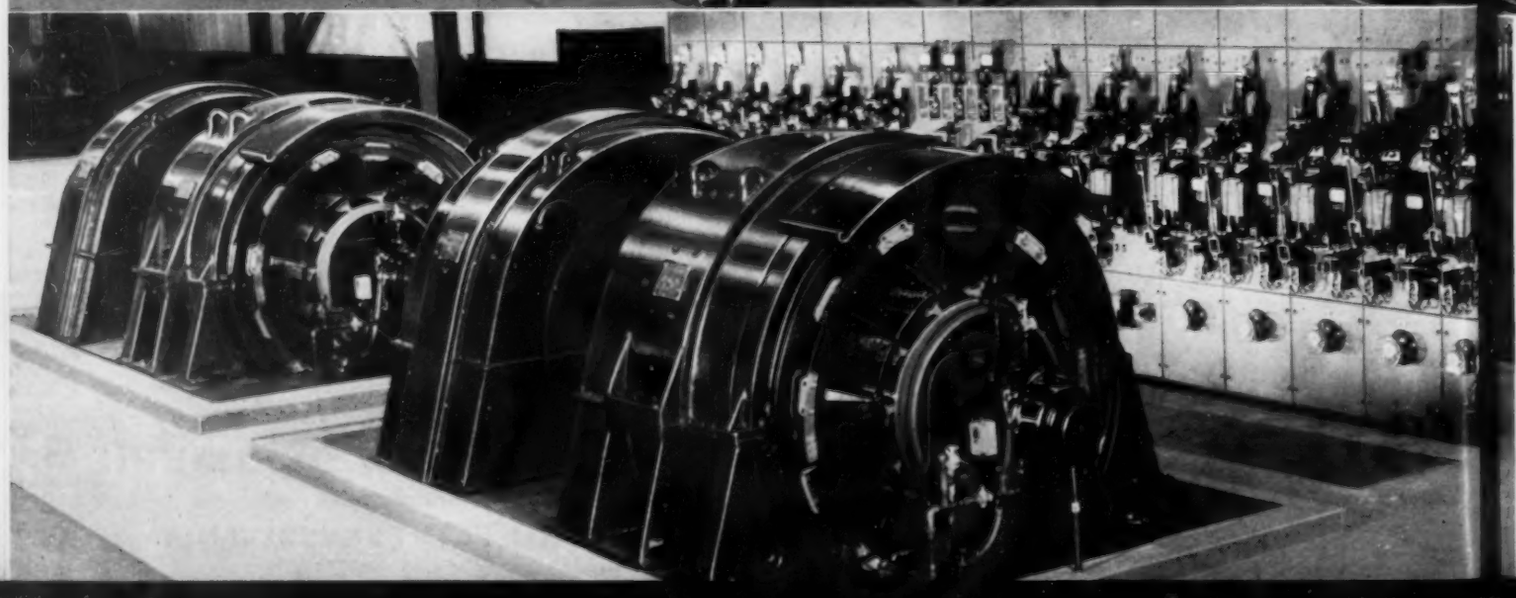
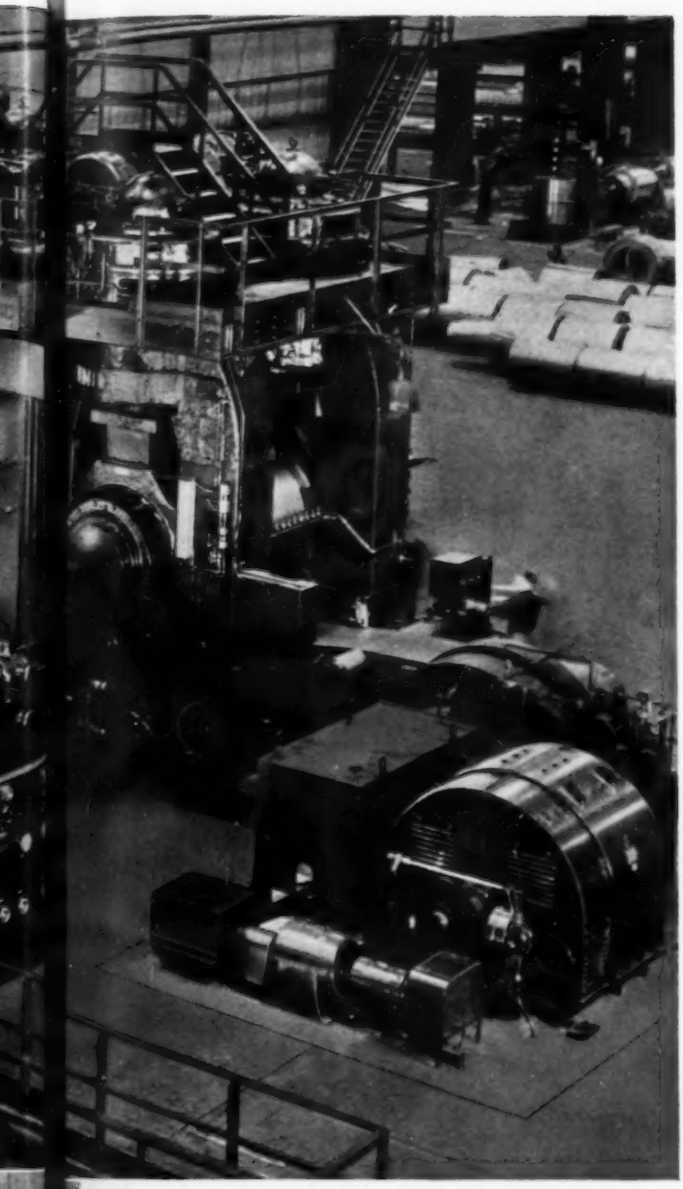




to Roll Steel!



Three stand, four high tandem 84-inch cold strip mill is driven by one 3500 and two 2500 hp main roll motors and an 800 hp delivery reel motor. All motors are forced ventilated and operate from 600 volts.

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A-C SUPPLIES HIGH AND LOW VOLTAGE

Two 25,000 kw turbine generators (lower right) supply electrical power for Carnegie's Edgar Thomson works and, in addition, are depended upon to supply power in the loop system for the rolling mills at Irvin works and the electric furnaces at Duquesne works. Three mammoth Allis-Chalmers 25,000 kva power transformers step down the high voltage for use throughout the Irvin works. A-C equipment also provides low voltage mill supply power at 250 volts d-c with five 1500 kw motor-generator sets (lower left).

At left is one of the many big mills at Irvin works powered and controlled by A-C equipment. Motors shown deliver 9300 hp to drive this 84-inch cold reduction mill. The supporting motor-generator set and control are also A-C engineered and built.

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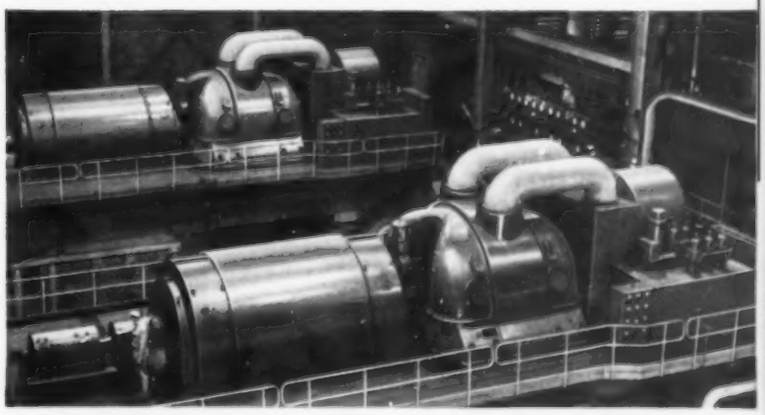

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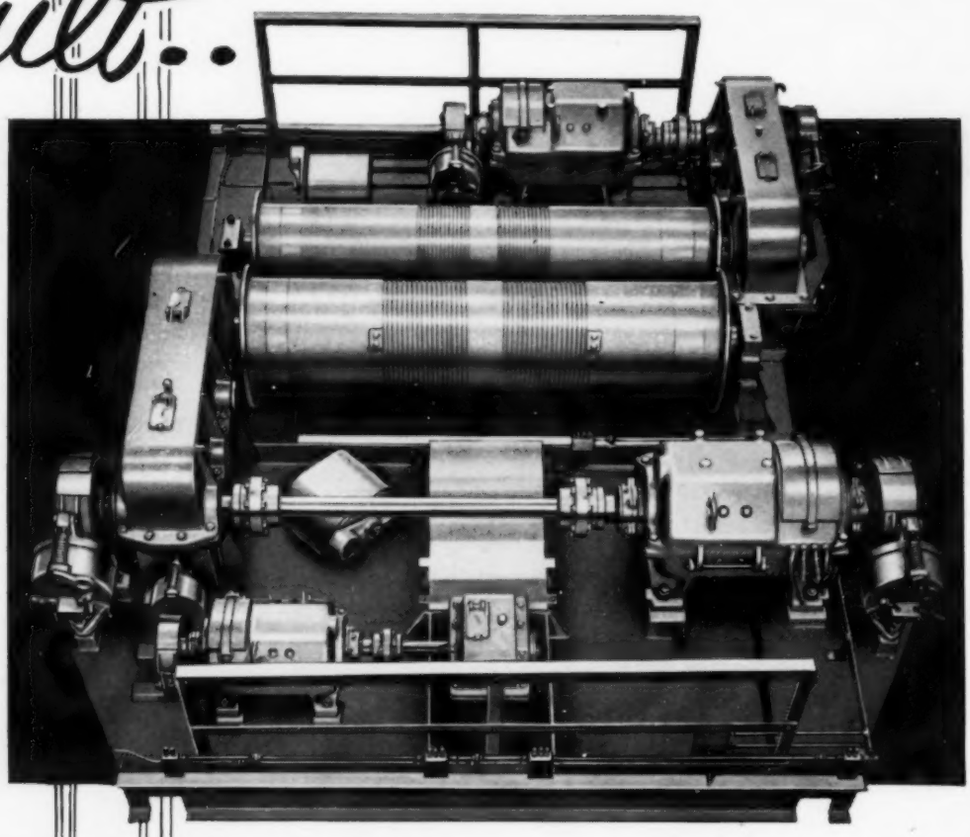

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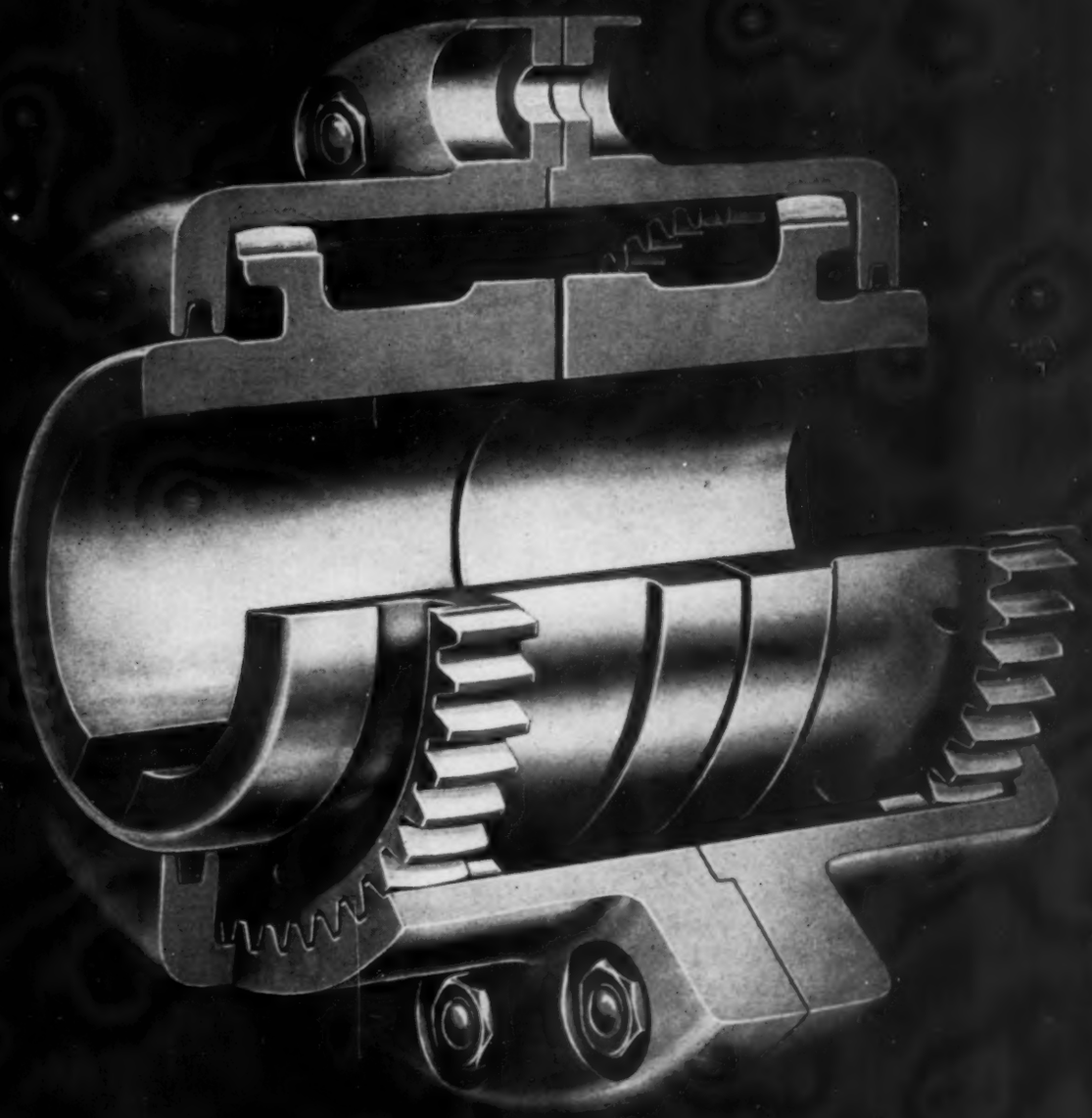

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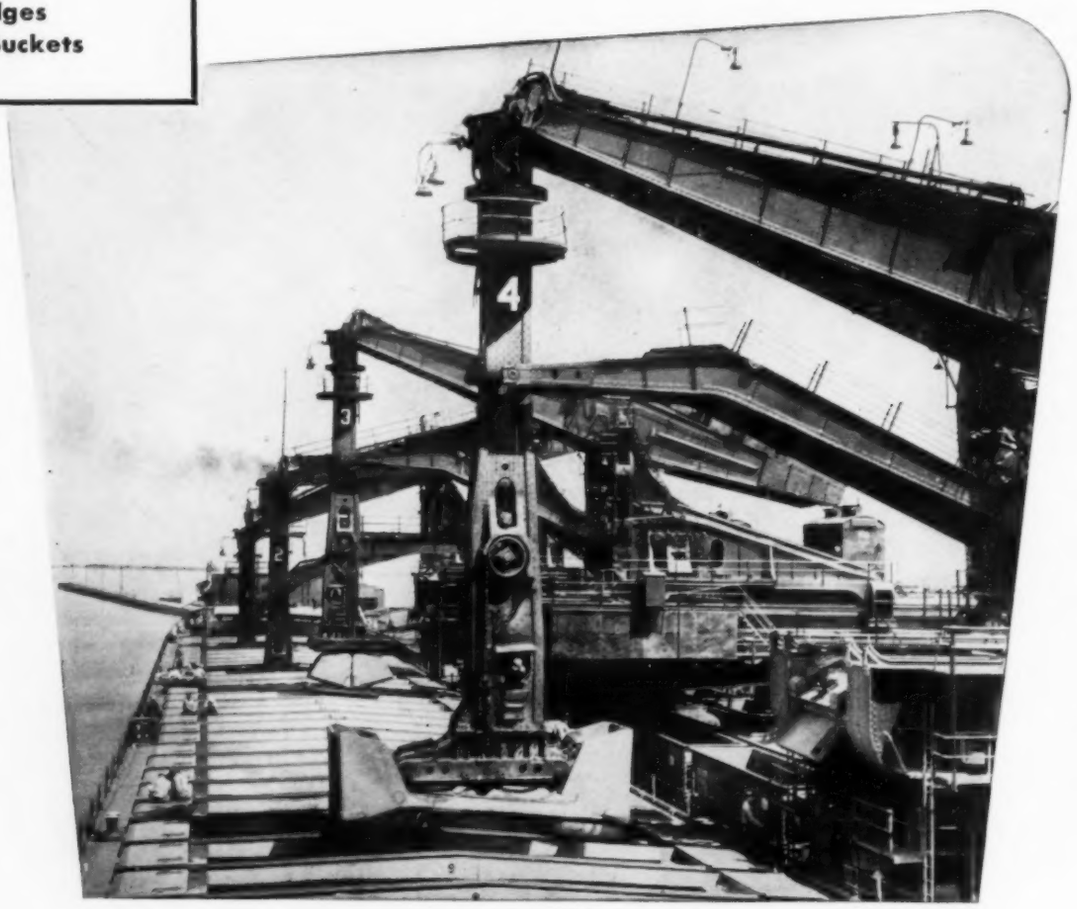

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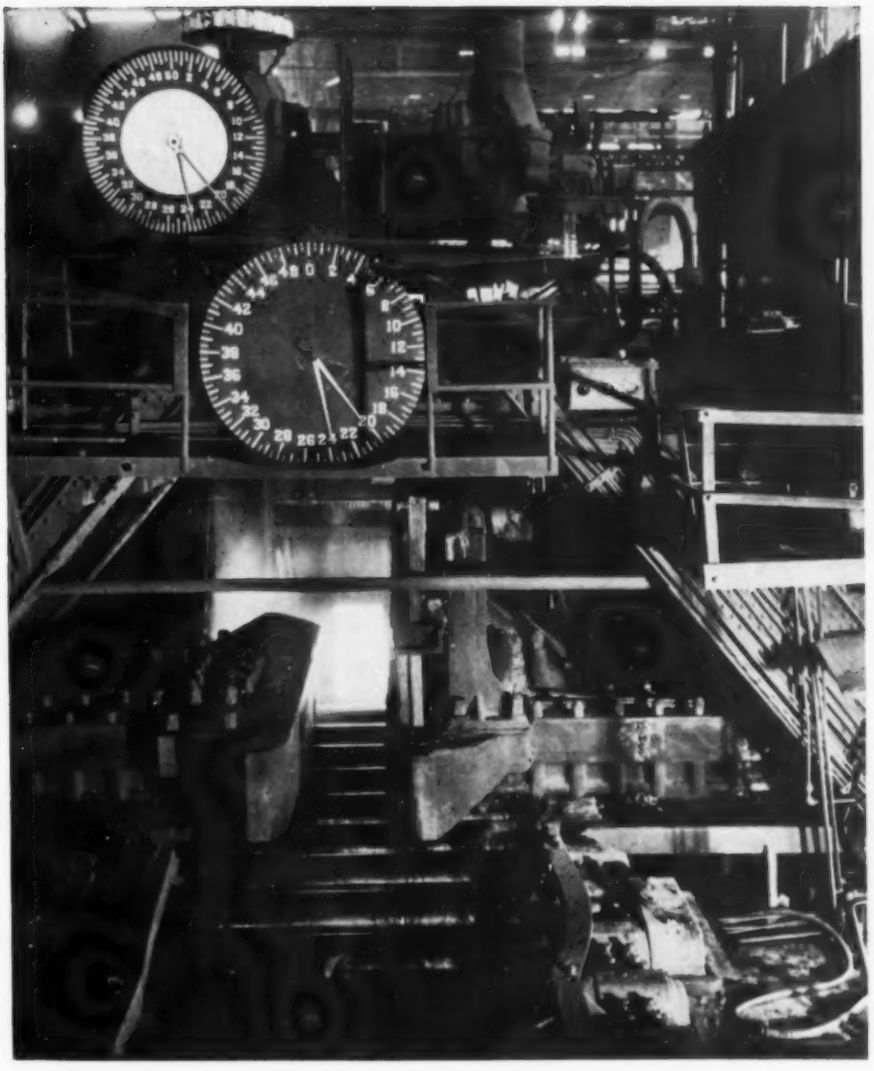

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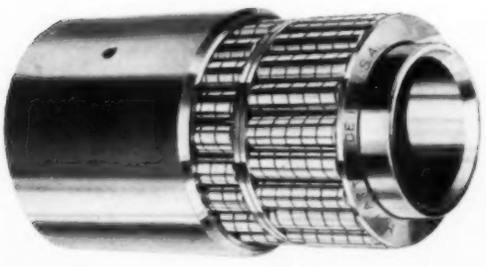

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Book Reviews

▲ "Refractories," just published by the General Refractories Co. of Philadelphia, supplies the little publicized but large and very important refractories field with a handbook of complete, accurate and up-to-date information. It is intended to serve those who design, use, purchase, construct and supervise the operation of equipment requiring refractory materials.

Its 272 pages, attractively and durably bound, cover the subject of refractories more completely than has heretofore been attempted. Beginning with a brief but interesting history of refractories from the sun-dried brick of old Egypt to the modern all-basic open hearth steel furnace, and including a history of the General Refractories Co. (one of the largest in this field) the book takes up every phase of refractory practice.

It describes the manufacture of refractory brick from raw material selection to the finished product. It tells what industries use refractories, where and why, and provides a guide to selection of the refractories best suited for each use. Grefco's complete line of refractory brick, mortars, plastics and castables is described. A section of the book lists, pictures, and gives dimensions of all standard refractory brick sizes and shapes. Another deals with the properties and behavior of refactories.

For engineers and architects who design and build equipment that requires refractories there is a great deal of information on construction with refractories as well as tables that simplify the calculation of numbers and types of brick needed. Perhaps as important as any other section of this refractories handbook is the glossary which defines, in some cases for the first time in print, the meanings of many terms used in this industry. And a complete index at the back facilities reference to any desired information.

This book is intended for distribution to refractories consumers and those who design and construct equipment employing refractory materials. Copies may be obtained at $5.00 each by writing to General Refractories Co., 1520 Walnut Street, Philadelphia 2, Pa.

▲ The Power Crane and Shovel Association has just released the "Operating Cost Guide Bulletin" as an aid to the owners of power cranes and shovels in correctively estimating the cost of ownership, operation and maintenance of this type of equipment. Aside from being of value to construction equipment owners, the breakdown of these costs should be of interest to contracting engineers, cost estimators, highway and public works administrators, plant and material handling engineers and engineering students majoring in construction methods and equipment. Copies of this pamphlet, "Technical Bulletin No. 2," may be obtained for fifty cents each by writing to the Power Crane and Shovel Association, No. 74 Trinity Place, New York 6, N. Y.

▲ Research Bulletin 2, "Some Fundamental Problems in the Manufacture of Steel by the Acid Open Hearth and the Acid Electric Processes" is actually a compilation of five technical papers which have been published on the subject of acid steel making processes. It combines all of these papers on the subject of acid melting problems under the same cover and, therefore, facilitates their use.

Research Copies of Bulletins may be obtained at $1.00 each by writing Acid Open Hearth Association, P. O. Box 1873, Pittsburgh Pa.

▲ A new edition of the "De Laval Engineering Handbook has just come off the press. The first edition of the Handbook was well received all through industry and this revision has been given careful attention to make it an even more useful reference book. This handbook is a useful source of practical information on the design, operation and installation of pumps, turbines, compressors and gears. Copies of the handbook are available at two dollars each from the Advertising Department, De Laval Steam Turbine Co., Trenton 2, N. J.

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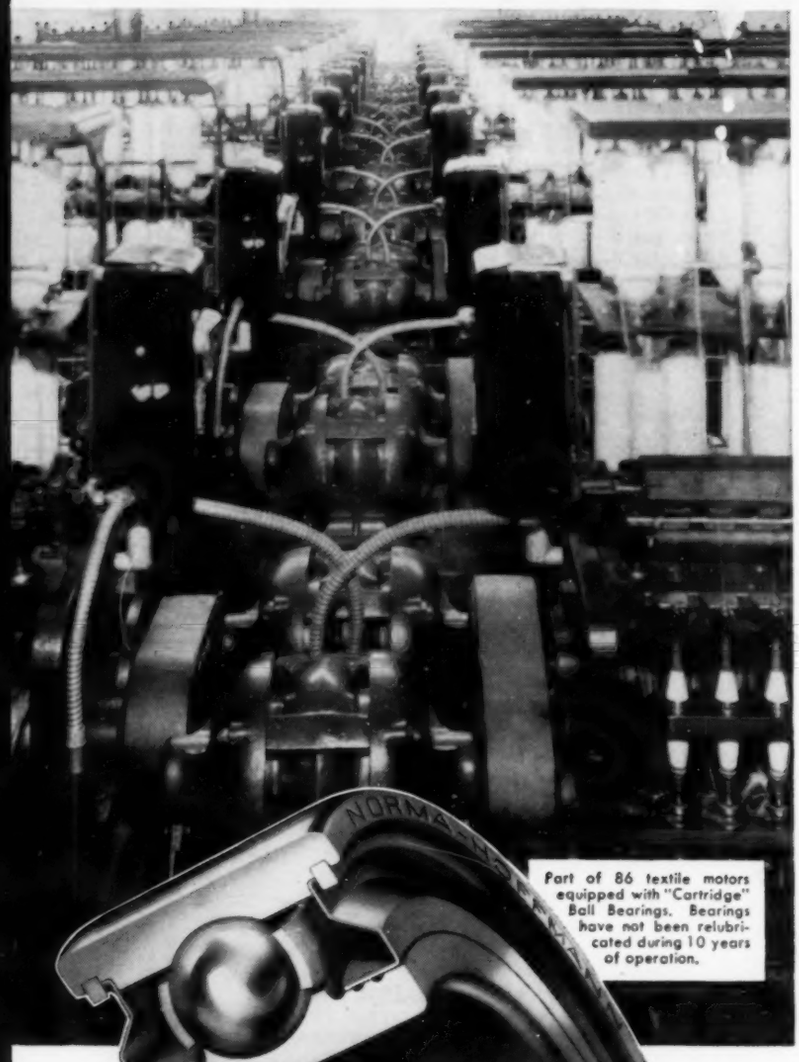
CASE HISTORY #819

646 Motors Operate 8 to 10 Years Without Relubrication or Bearing Failures ...and they're still going strong



Part of 86 textile motors equipped with "Cartridge" Ball Bearings. Bearings have not been relubricated during 10 years of operation.

Norma-Hoffmann

Patented "Cartridge" Bearings increase the "Life-Span" of Equipment

Records prove that Norma-Hoffmann "Cartridge" ball bearings give continuous performance in hundreds of applications without failure.

For example — 646 motors in 5 textile mills have been operating practically continuously for 8 to 10 years without relubrication. On inspection of many of the motors, the bearings showed no appreciable wear and the original grease was in good condition for many more years of operation.

Made to double-row width, Norma-Hoffmann "Cartridge" bearings have 100% more grease capacity than conventional width sealed bearings. The highly efficient seals keep dirt out, grease in. Factory-packed with Norma-Hoffmann's specially compounded "stability-tested" grease . . . grease that is highly resistant to oxidation and breakdown . . . assures dependable operation for long periods without regreasing.

Investigate the "Cartridge" ball bearing for your products whether they be motors, machine tools, pumps or other machinery. Our engineers are always available for consultation about your bearing applications. Write for their services.

NORMA-HOFFMANN *Precision* **BEARINGS**

BALL • ROLLER • THRUST

NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONNECTICUT

Field Offices: New York • Chicago • Cleveland • Detroit • Pittsburgh • Cincinnati • Los Angeles • San Francisco • Dallas • Seattle • Phoenix

World's fastest strip mill has Farval automatic lubrication

THE mill that rolls tinplate at 70 miles per hour is lubricated by Farval. One heavy duty automatic system serves work roll bearings and another supplies back up roll thrusts, pressure blocks, spindle carriers, chuck slides and roll balance cylinders. Still other Farval systems are installed on the continuous pickler, flash welder and uncoiler—a total of 13 automatic and manual systems serving 561 bearings in this one steel plant department.

Since the original cold strip mill installations in 1930, more than 90% of all the continuous cold mills built have been equipped with Farval. Farval likewise serves the vast majority of the world's hot strip mills—well over 70% of the mills in America and abroad.

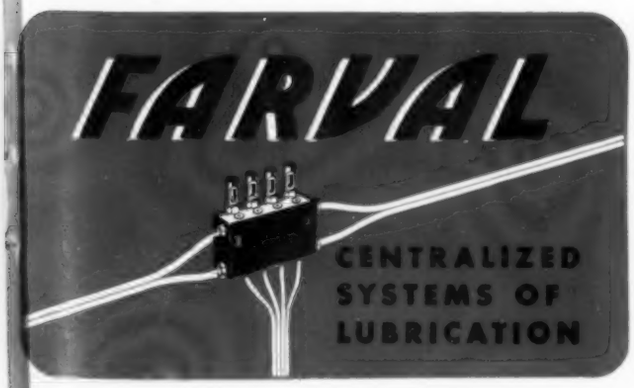
In short, wherever it is important that bearings function dependably under heavy pressures and at high speeds, you'll find Farval on the job. In hundreds of steel and metal-working plants, Farval Centralized Lubrication has long since proved its ability to save time, lubricant and oiling labor, eliminate bearing expense, and most important of all, reduce down time for bearing replacement or repair, and thereby increase mill and machine production.

Farval has proven itself in over 20 years of service. It is the original Dualine system of centralized lubrication that others imitate. The Farval valve has only 2 moving parts—is simple, sure and foolproof, without springs, ball-checks or pinhole ports to cause trouble. Through its wide valve ports, and full hydraulic operation, Farval unfailingly delivers grease or oil to each bearing—as much as you want, exactly measured—as often as desired. Indicators at every bearing show that each valve has functioned. For a full description, write for Bulletin No. 25.

The Farval Corporation, 3278 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.

FARVAL—
Studies in Centralized Lubrication
No. 111



Now fully ventilated at any speed!

New double-blower cooling system permits these standard motors to deliver full torque even at very low speeds

Here's the newest improvement in General Electric standard, totally enclosed, unit-cooled d-c motors! Now, in ratings up to 200 hp, they're available with a new type air-to-air cooling assembly which makes ventilation entirely independent of motor speed. These motors can run at slow speeds over long periods of time, deliver full torque continuously, and should be applied where a motor must continuously deliver torques which would overheat a standard motor when running below rated basic speed.

Clean, cool motor air—at all times Ventilation is provided by a single Tri-Clad induction motor driving two blowers at constant speeds. Ventilation is maintained without regard to the speed of the main motor shaft. One blower circulates internal air through motor and unit cooler, the other circulates external air through the cooler. Motor air, never in contact with contaminated outside air, is cooled by flowing through passages set at right angles to the external air passages. Safe winding temperatures are thus maintained at all times.

Simpler installation, less maintenance Designed for steel mill and similar applications in dusty, dirty, and oil-laden atmospheres, these sturdy, protected motors need no piping, ductwork, air filters, or pressurized air supply. Installation is further simplified because motor and cooling system are factory-assembled as a unit. Totally enclosed construction reduces shutdowns for cleaning, inspection and repair.

GET THE WHOLE STORY! To find out how these better-cooled, better-protected d-c motors can help cut costs in your mill, call in a G-E engineer, or write for new Bulletin GEA-4469. ***Apparatus Dept., General Electric Company Schenectady 5, New York.***

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